

# 2300A

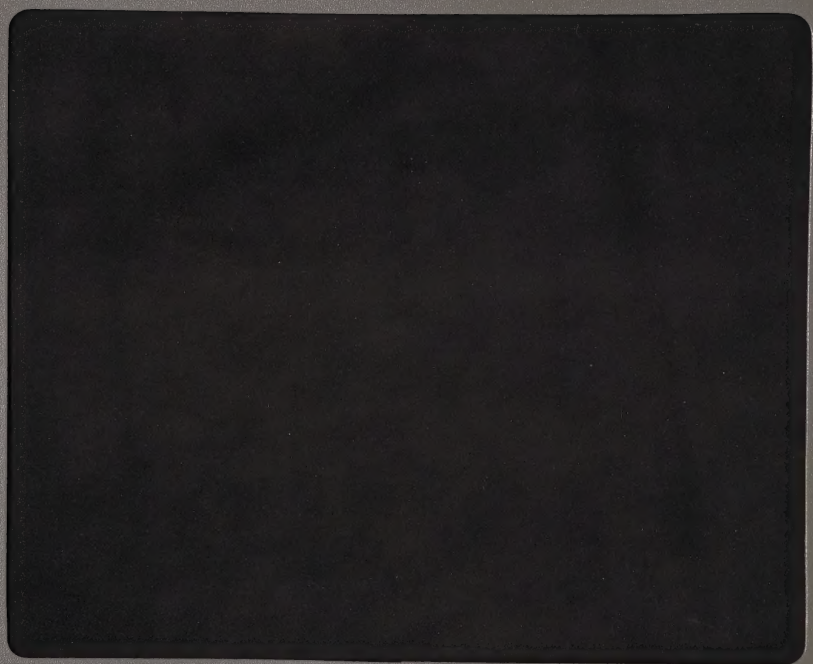
## Scanner

Property of Dept. 8371  
ITT AEROSPACE/OPTICAL DIV.

Instruction Manual







#### NOTE

This manual documents the Model 2300A and its assemblies at the revision levels shown in Appendix 7A. If your instrument contains assemblies with different revision letters, it will necessary for you to either update or backdate this manual. Refer to the supplemental change/errata sheet for newer assemblies, or to the backdating sheet in Appendix 7A for older assemblies.

# 2300A Scanner

Property of Dept. 8371  
ITT AEROSPACE/OPTICAL DIV.

## Instruction Manual

P/N 522078  
January 1980





# WARRANTY

Notwithstanding any provision of any agreement the following warranty is exclusive:

The JOHN FLUKE MFG. CO., INC., warrants each instrument it manufactures to be free from defects in material and workmanship under normal use and service for the period of 1-year from date of purchase. This warranty extends only to the original purchaser. This warranty shall not apply to fuses, disposable batteries (rechargeable type batteries are warranted for 90-days), or any product or parts which have been subject to misuse, neglect, accident, or abnormal conditions of operations.

In the event of failure of a product covered by this warranty, John Fluke Mfg. Co., Inc., will repair and calibrate an instrument returned to an authorized Service Facility within 1 year of the original purchase; provided the warrantor's examination discloses to its satisfaction that the product was defective. The warrantor may, at its option, replace the product in lieu of repair. With regard to any instrument returned within 1 year of the original purchase, said repairs or replacement will be made without charge. If the failure has been caused by misuse, neglect, accident, or abnormal conditions of operations, repairs will be billed at a nominal cost. In such case, an estimate will be submitted before work is started, if requested.

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**If any failure occurs, the following steps should be taken:**

1. Notify the JOHN FLUKE MFG. CO., INC., or nearest Service facility, giving full details of the difficulty, and include the model number, type number, and serial number. On receipt of this information, service data, or shipping instructions will be forwarded to you.
2. On receipt of the shipping instructions, forward the instrument, transportation prepaid. Repairs will be made at the Service Facility and the instrument returned, transportation prepaid.

## **SHIPPING TO MANUFACTURER FOR REPAIR OR ADJUSTMENT**

All shipments of JOHN FLUKE MFG. CO., INC., instruments should be made via United Parcel Service or "Best Way" prepaid. The instrument should be shipped in the original packing carton; or if it is not available, use any suitable container that is rigid and of adequate size. If a substitute container is used, the instrument should be wrapped in paper and surrounded with at least four inches of excelsior or similar shock-absorbing material.

## **CLAIM FOR DAMAGE IN SHIPMENT TO ORIGINAL PURCHASER**

The instrument should be thoroughly inspected immediately upon original delivery to purchaser. All material in the container should be checked against the enclosed packing list. The manufacturer will not be responsible for shortages against the packing sheet unless notified immediately. If the instrument is damaged in any way, a claim should be filed with the carrier immediately. (To obtain a quotation to repair shipment damage, contact the nearest Fluke Technical Center.) Final claim and negotiations with the carrier must be completed by the customer.

The JOHN FLUKE MFG. CO., INC., will be happy to answer all applications or use questions, which will enhance your use of this instrument. Please address your requests or correspondence to: JOHN FLUKE MFG. CO., INC., P.O. BOX C9090, EVERETT, WASHINGTON 98206, ATTN: Sales Dept. For European Customers: Fluke (Holland) B.V., P.O. Box 5053, 5004 EB, Tilburg, The Netherlands.

\*For European customers, Air Freight prepaid.

**John Fluke Mfg. Co., Inc., P.O. Box C9090, Everett, Washington 98206**



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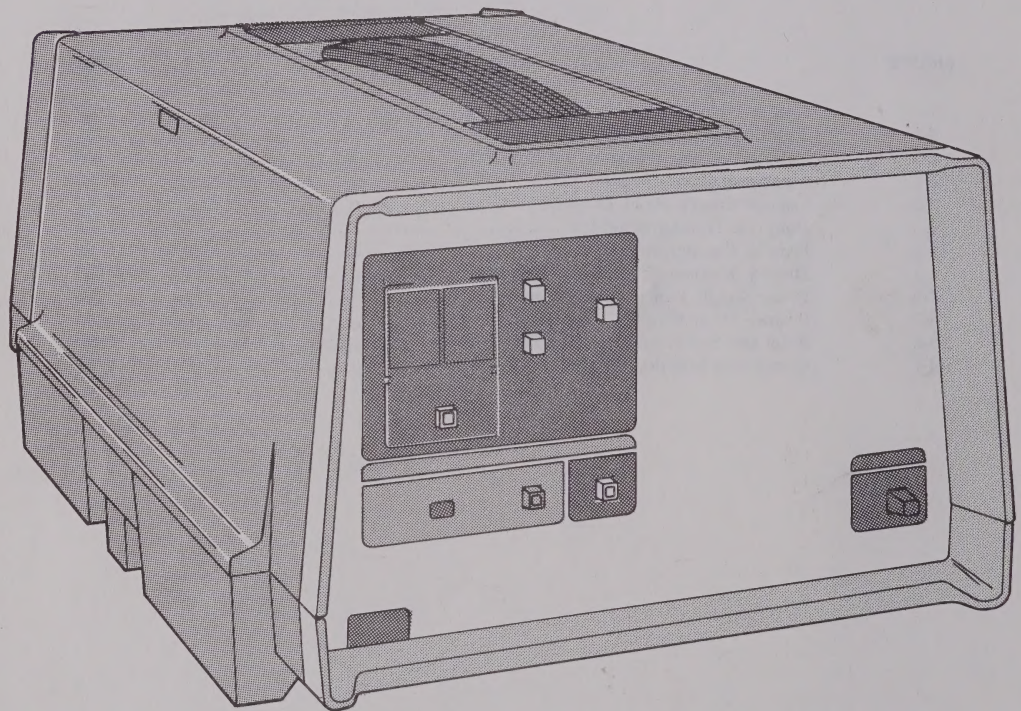
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2300A Scanner



## Section 1

# Introduction & Specifications

### 1-1. INTRODUCTION

1-2. The Model 2300A Scanner Mainframe is a measurement instrument scanner that accepts analog inputs and supplies those inputs to an appropriate measurement/test instrument in sequence. Two scanner cards, each containing 10 scan channels, may be installed in the 2300A. With the addition of three 2301A Scanner Extender chassis, system scan capability may be expanded to a maximum of 100 channels. Bidirectional communication between the scanner mainframe and other system instruments is through an I/O interface option. All scanner inputs and outputs, as well as some scanner functions, are dependent upon the scanner card and interface options selected. Refer to Section 6 of this manual for scanner card and interface option information.

1-3. The 2300A front panel controls allow the operator to manually scan all channels, program channel delay times, skip specific channels, or scan all channels automatically. A Fluke Model 2020A-004, 2021A-004, or 2030A printer may be connected to the 2300A output to provide recording capability for the scanner system. Front panel displays provide an indication of the selected channel or channel delay time, and the selected scan mode.

1-4. All scanner cards and I/O Interface cards are supplied as options, and the specific options selected determine most scanner system functions and input requirements. Each scanner card option provides connections for 10 channels, and each card is divided into

two groups of five channel connections. Scanner cards have manual, channel-skip switches for each channel.

1-5. Scanner Mainframe power may be supplied through either of two rear panel connectors, and may be any one of three different voltages: 100 to 130V ac, 200 to 260V ac, or 10 to 15V dc. Power in either ac voltage range is supplied through the same three-wire, grounded power cord and the same U-ground, three-pin connector on the 2300A rear panel. The ac voltage ranges are internally switch-selectable. The ac power requirement is 8 watts; ac frequency must be between 47 and 440 Hz. Scanner dc power is supplied through a two-pin terminal block with screw-type connections. Both ac and dc power may be connected simultaneously. The 2300A will operate from the ac supply, but, if the ac supply is interrupted, the 2300A will switch automatically to dc operation with no interruption. Independent operation from either power source is possible.

1-6. The Model 2300A Scanner Mainframe is housed in a PTI (portable test instrument) case. This lightweight, durable plastic case makes the scanner truly portable when used with a portable dc power supply. PTI cases may be stacked and latched together to form a portable test system. The Scanner Extender (2301A), and printer (2020A-004, 2021A-004, and 2030A) are also packaged in PTI cases.

### 1-7. SPECIFICATIONS

1-8. Table 1-1 lists specifications for the Model 2300A Scanner Mainframe. Specifications for each option and each accessory are listed in the appropriate part of Section 6 in this manual.

Table 1-1. 2300A Specifications

**OPERATING CHARACTERISTICS**

- CHANNEL CAPACITY:** 20 channels internal; control capability for additional 80 channels in 2301A Extender Chassis. 100 channels system maximum.
- SCAN SPEED:** Dependent upon measurement instrument and operator-selected delay time.
- CHANNEL DELAY:** Operator-selectable: 0 to 9.9 sec.
- SCAN MODES:** Manual or Automatic.
- CHANNEL DISPLAY:** 2 Digit LEDs
- DELAY TIME DISPLAY:** 2 Digit LEDs
- REQUIRED OPTIONS:** One Scanner Card Option and one Interface Option.

**ENVIRONMENTAL REQUIREMENTS**

- OPERATING ENVIRONMENT:** 0°C to 50°C (32°F to 122°F), 75% Relative Humidity
- STORAGE ENVIRONMENTS:** -20°C to +70°C (-4°F to +158°F), 95% Relative Humidity

**GENERAL SPECIFICATIONS**

- WEIGHT:** Approximately 8 pounds (dependent upon the options installed).
- POWER REQUIREMENT:** 8 watts; 100 to 130V ac or 200 to 260V ac, 47 to 440 Hz. (Switch selectable). 10V to 15V dc.
- CASE SIZE:** 20.45 cmW x 13.08 cm H x 32.69 cm L (8.05 in W x 5.15 in H x 12.85 in L). See Figure 1-1.
- PROTECTION CLASS 1:** Relates solely to insulation or grounding properties as defined in IEC 348.

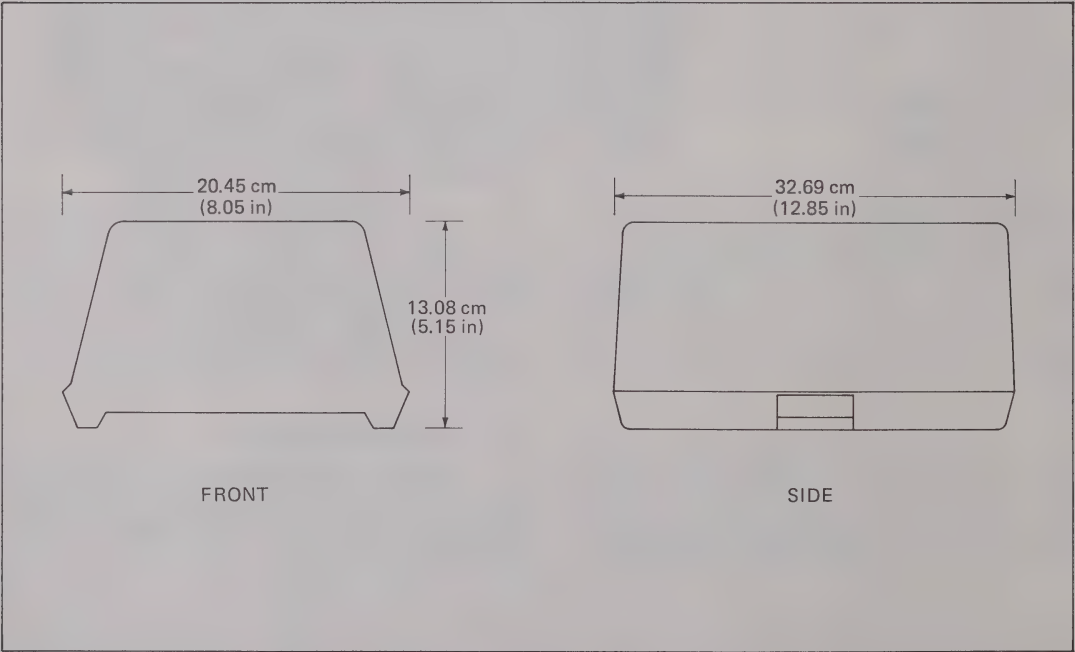


Figure 1-1. Outline Drawing

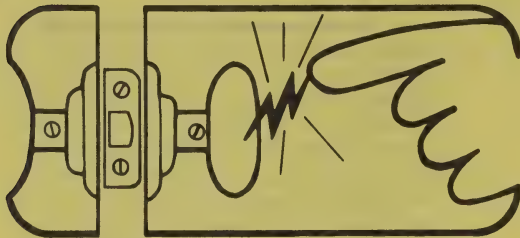




# static awareness



A Message From  
**John Fluke Mfg. Co., Inc.**

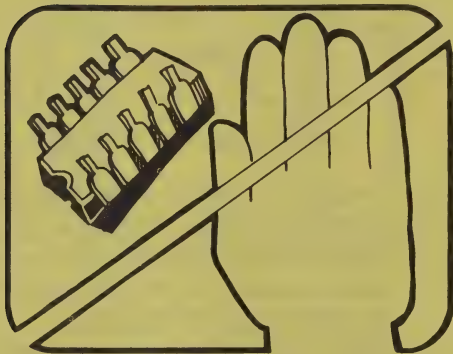


Some semiconductors and custom IC's can be damaged by electrostatic discharge during handling. This notice explains how you can minimize the chances of destroying such devices by:

1. Knowing that there is a problem.
2. Learning the guidelines for handling them.
3. Using the procedures, and packaging and bench techniques that are recommended.

The Static Sensitive (S.S.) devices are identified in the Fluke technical manual parts list with the symbol "ⓧ"

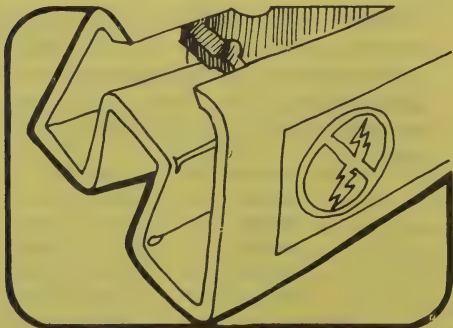
The following practices should be followed to minimize damage to S.S. devices.



1. MINIMIZE HANDLING



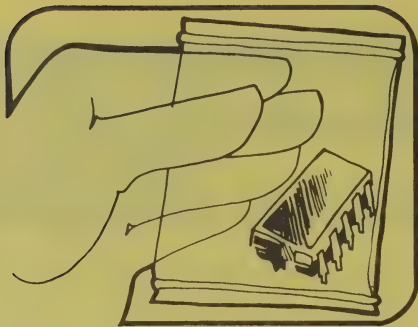
3. DISCHARGE PERSONAL STATIC BEFORE HANDLING DEVICES



2. KEEP PARTS IN ORIGINAL CONTAINERS UNTIL READY FOR USE.



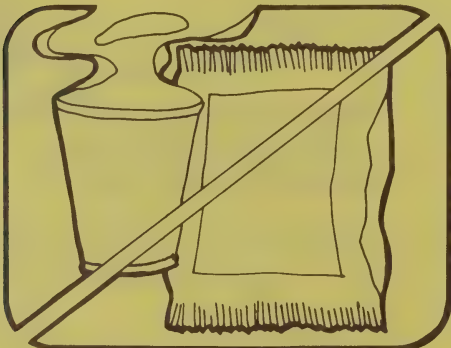
4. HANDLE S.S. DEVICES BY THE BODY



5. USE ANTI-STATIC CONTAINERS FOR HANDLING AND TRANSPORT

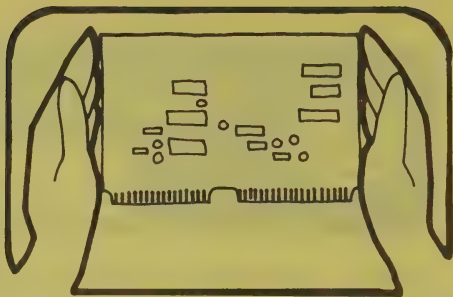


6. DO NOT SLIDE S.S. DEVICES OVER ANY SURFACE

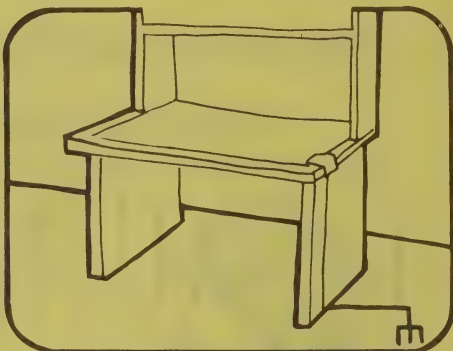


7. AVOID PLASTIC, VINYL AND STYROFOAM® IN WORK AREA

PORTIONS REPRINTED  
WITH PERMISSION FROM TEKTRONIX, INC.  
AND GENERAL DYNAMICS, POMONA DIV.



8. WHEN REMOVING PLUG-IN ASSEMBLIES, HANDLE ONLY BY NON-CONDUCTIVE EDGES AND NEVER TOUCH OPEN EDGE CONNECTOR EXCEPT AT STATIC-FREE WORK STATION. PLACING SHORTING STRIPS ON EDGE CONNECTOR USUALLY PROVIDES COMPLETE PROTECTION TO INSTALLED SS DEVICES.



9. HANDLE S.S. DEVICES ONLY AT A STATIC-FREE WORK STATION  
10. ONLY ANTI-STATIC TYPE SOLDER-SUCKERS SHOULD BE USED.  
11. ONLY GROUNDED TIP SOLDERING IRONS SHOULD BE USED.

Anti-static bags, for storing S.S. devices or pcbs with these devices on them, can be ordered from the John Fluke Mfg. Co., Inc.. See section 5 in any Fluke technical manual for ordering instructions. Use the following part numbers when ordering these special bags.

| John Fluke Part No. | Description   |
|---------------------|---------------|
| 680892              | 5" x 8" Bag   |
| 680934              | 8" x 10" Bag  |
| 680942              | 8" x 12" Bag  |
| 680983              | 12" x 16" Bag |
| 681023              | 18" x 18" Bag |
| Pink Poly Sheet     | Wrist Strap   |
| 30" x 60" x 60 Mil  | P/N TL6-60    |
| P/N RC-AS-1200      | \$7.00        |
| \$20.00             |               |

## Section 2

# Operating Instructions

### 2-1. INTRODUCTION

2-2. This section of the manual contains information regarding installation and operation of the 2300A Scanner Mainframe. It is recommended that the contents of this section be read and understood before any attempt is made to operate the instrument. Should any difficulties arise during operation, please contact your nearest Fluke Technical Service Center, or the John Fluke Mfg. Co., Inc; P.O. Box 43210, Mountlake Terrace, WA 98043; telephone (206) 774-2211. A list of Technical Service Centers is located in Section 7 of this manual.

### 2-3. SHIPPING INFORMATION

2-4. The 2300A is packaged and shipped in a foam-packed container. Upon receipt of the instrument, a thorough inspection should be made to reveal any shipping damage. Special instructions for inspection and claims are included on the shipping container.

2-5. If reshipment of the instrument is necessary, the original container should be used. If the original container is not available, a new one can be obtained from the John Fluke Mfg. Co., Inc. Please reference the instrument model number when requesting a new shipping container.

### 2-6. INPUT POWER

2-7. A Model 2300A Scanner Mainframe will operate with any one of three possible input voltages: 100 to 130V ac, 200 to 260V ac, or 10 to 15V dc. The two ac voltage ranges are switch-selectable; line frequency in either ac range must be between 47 and 440 Hz. Refer to Section 4 of this manual for ac line voltage selection or verification instructions. The 2300A will also operate from a 10 to 15V dc supply; 12V dc is the optimum supply voltage. External 12V dc connections are provided on the rear panel. The connections are screw-type, terminal block connections, and they are marked for polarity.

### CAUTION

**Before connecting the 2300A to the local line voltage, verify that the input voltage switch setting corresponds to the local line voltage.**

2-8. The rear panel power ac connector is a three-prong, European connector which permits the 2300A to be connected, through a power cord, to the applicable line voltage. The offset ground prong on this connector should be connected, through the power cord, to a high quality earth ground.

### 2-9. INSTALLATION

### 2-10. Typical Scanner System Configurations

#### NOTE

*Disconnect all inputs to the test instrument before connecting the scanner.*

2-11. A basic, 20-channel scanner system may be configured from a Model 2300A Scanner Mainframe, two scanner option cards, one interface option card, and an appropriate measurement test instrument. Figure 2-1 illustrates typical scanner system configurations. This basic system will scan and display information from 10 or 20 inputs either manually or automatically, with programmable skips and single channel monitoring capability. Information from each input is displayed in sequence on the test instrument display.

2-12. To configure a basic 20-channel scanner system, use the following procedure:

1. If the test instrument is packaged in a PTI case, pull out the two latches on the side of the test instrument case, place the test instrument on top of the Scanner Mainframe case, then push the latches in to fasten the two cases together.



- 2. Connect the desired number of input sensors to the selected scanner card option. (Refer to connection instructions for the applicable scanner card option in Section 6 of this manual).
- 3. Connect the 2300A to the test instrument. Refer to the applicable interface option installation instructions.
- 4. Connect the appropriate input power to each instrument.
- 5. Consult operating instructions located in this section of the manual.

2-14. Recording capability may be added to the basic scanner system with the addition of a PTI packaged printer (Model 2020A-004, 2021A-004, or 2030A). To add a printer to the system, pull out the latches on the side of the 2300A case, then place the scanner and test instrument on top of the printer, and push the latches in to fasten the cases together. Connect the printer I/O connector to the 2300A DATA I/O CONNECTOR using a PTI system accessory cable.

2-15. System capability may be expanded to 100 channels through the addition of Model 2301A Scanner Extender chassis. A maximum of three Scanner Extenders may be added to the 2300A Scanner Mainframe. Each additional Scanner Extender adds 30 channels to the system capability. One additional scanner extender provides a system scan capability of 50 channels; two additional scanner extenders provide a scan capability of 80 channels; three additional scanner extenders provide system scan capability of 100 channels. Addition of the third scanner extender provides only 20 additional channels due to 2300A control limitations.

2-16. Each scanner extender has a connecting cable extending from the rear panel. These cables may be connected in a daisy-chain fashion, from each scanner extender to the previous scanner extender connector, and from the first scanner extender to the 2300A SCANNER EXTENDER CONNECTOR. Scanner Extenders are packaged in PTI cases also, and they may be stacked on top of the test instrument in a system and latched to it as described previously.

**2-17. Rack Mounting**

2-18. Printers, 2300A Scanner Mainframes, scanner extenders, and all other PTI packaged test instruments may be mounted in a standard 19-inch electronics equipment rack. Rack mounting requires use of the applicable rack panel accessory. The 2300A Scanner Mainframe, and compatible scanner extenders, and printers are all housed in D-size PTI cases. A single D-size PTI instrument may be rack mounted using Rack Panel Accessory Y2016; two D-size PTI instruments may be rack mounted using Rack Panel Accessory Y2017.

**2-19. OPERATING FEATURES**

2-20. All controls, indicators, and connectors are shown in Figure 2-2; all control, indicator, and connector functions are described in Table 2-1. Additional functions and features may be available with certain interface option boards installed. Refer to the applicable portion of Section 6 in this manual for additional interface option information.

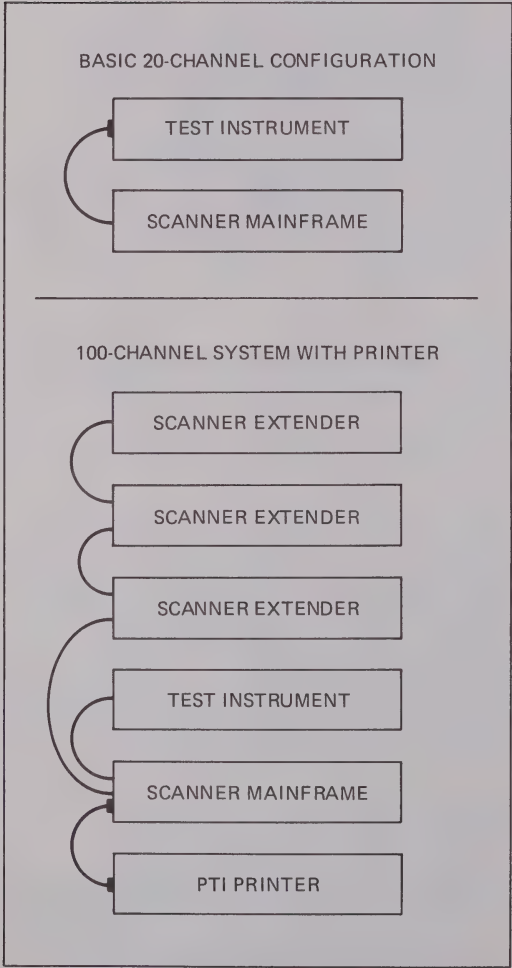


Figure 2-1. Typical Scanner System Configurations

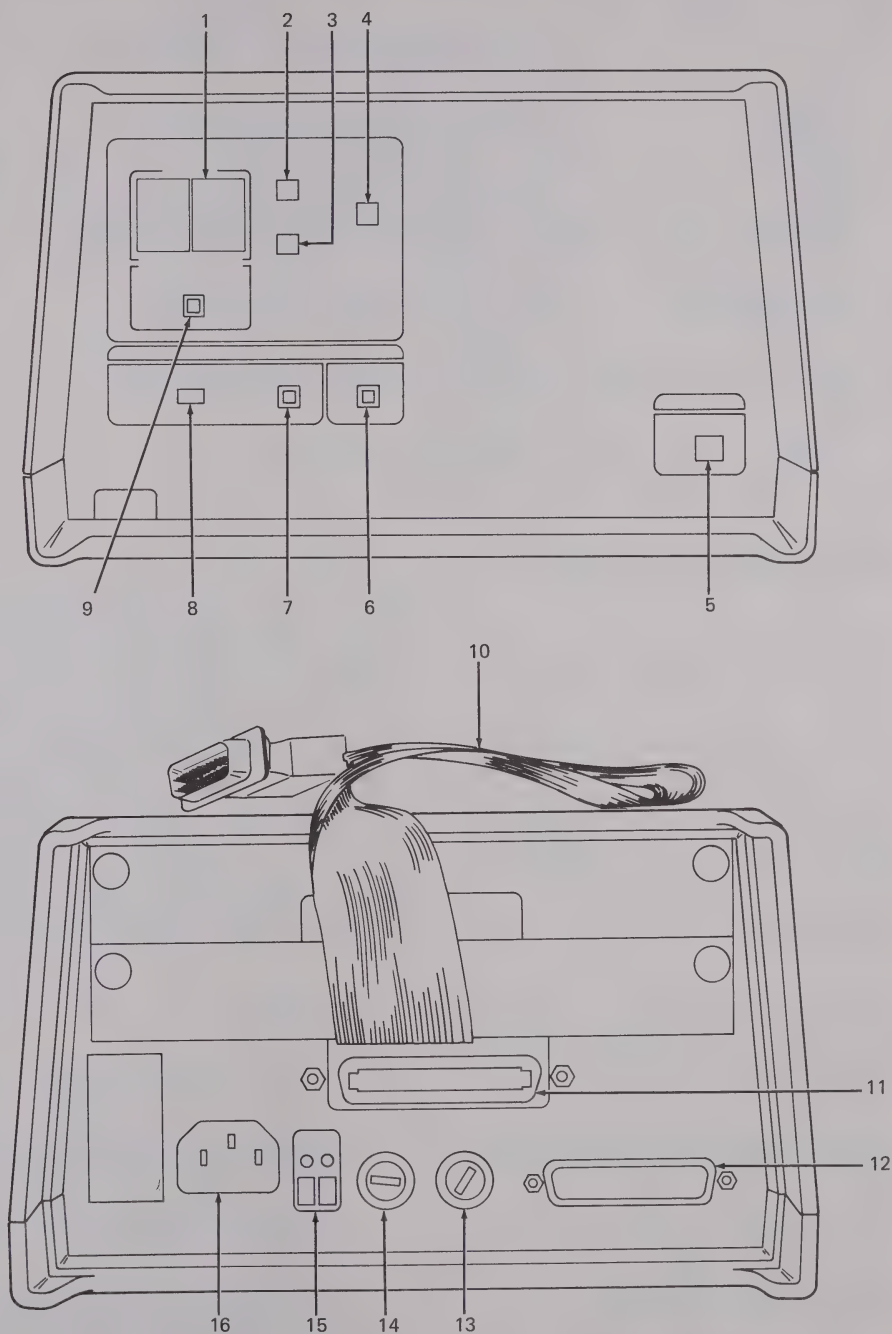


Figure 2-2. 2300A Controls, Indicators and Connectors

Table 2-1. Controls, Indicators, and Connectors

| REF. NO. | NAME                       | FUNCTION                                                                                   |
|----------|----------------------------|--------------------------------------------------------------------------------------------|
| 1        | Channel                    | Displays channel being scanned or channel delay time.                                      |
| 2        | Up                         | Increments Display.                                                                        |
| 3        | DN                         | Decrements Display.                                                                        |
| 4        | Skip Select                | Programs skip or un-skip of displayed channel.                                             |
| 5        | POWER                      | Switches power to scanner circuitry.                                                       |
| 6        | MANUAL                     | Allows manual operator channel scanning and Front Panel programming.                       |
| 7        | AUTO                       | Selects automatic channel scanning.                                                        |
| 8        | REMOTE                     | Light indicates a remote device is controlling the scanner.                                |
| 9        | Channel Delay Select       | Channel delay time is displayed when select switch is pressed. If 2300A is in manual mode. |
| 10       | Instrument Cable           | Cable mounted connection to test instrument.                                               |
| 11       | Data I/O Connector         | Bidirectional communication connector for printer or system controller.                    |
| 12       | Scanner Extender Connector | Connector for Model 2301A Scanner Extender Chassis.                                        |
| 13       | F2                         | DC Power Fuse.                                                                             |
| 14       | F1                         | AC Power Fuse.                                                                             |
| 15       | 12V DC                     | Connecor for external DC supply.                                                           |
| 16       | Line Voltage Connector     | Line Voltage Input.                                                                        |

## 2-21. Channel Delay Time Selection

### NOTE

*Fluke digital thermometers require a minimum delay time of 2 seconds.*

2-22. The minimum time that the scanner spends on each channel is operator programmable from the front panel. A delay time sufficient to allow the test instrument in use to stabilize must be selected. The operator can select a delay time ranging from 0 to 9.9 seconds. Use the following procedure to program a new delay time:

1. Push the MANUAL switch to place the scanner in manual mode.
2. Push the CHANNEL DELAY SELECT switch. The switch will light, and current delay time will be displayed on the channel indicator. The decimal point will light also, indicating that the delay time is in tenths of a second.
3. Push the UP or DN switch to increment or decrement the channel delay time to the desired value.
4. Push the MANUAL switch, then the AUTO switch to resume scanning.

## 2-23. Channel Skip Programming

2-24. Any single channel, or any group of channels may be skipped, at the operators discretion. Skip

programming may be initiated only in the manual operating mode. When incrementing through the channels in manual operation, the light above the SKIP SELECT switch will light for each channel that is skipped. The mass skip feature allows the operator to copy the skip state through large blocks of channels. Mass skip is a "soft" skip in that it does not effect skips previously programmed individually. When a block of channels is mass skipped, then mass unskipped, those channels that were programmed individually to be skipped will remain in a skipped state. While mass skip is programmed, all channels within the block will be skipped, but when the mass skip is reset, only those channels individually programmed for skip (and the first mass-skipped channel) will remain skipped. To program the skip or mass skip feature, use the following procedure:

1. Push the MANUAL switch to establish manual operation.
2. Push the UP or DN switch to increment or decrement to the desired channel.
3. If the SKIP SELECT light is on, that channel is programmed to skipped; if the SKIP SELECT light is off, that channel will not be skipped.
4. To change the skip state of a single channel, push the SKIP SELECT switch.
5. To mass-skip a block of channels, push the SKIP SELECT switch, and, while keeping the SKIP SELECT switch depressed, push the UP or DN switch to increment or decrement through the block of channels to be skipped or unskipped.



# CHANGE/ERRATA INFORMATION

ISSUE NO: 2

3/82

This change/errata contains information necessary to ensure the accuracy of the following manual. Enter the corrections in the manual if either one of the following conditions exist:

1. The revision letter stamped on the indicated PCB is equal to or higher than that given with each change.
2. No revision letter is indicated at the beginning of the change/errata.

## MANUAL

Title: 2300A Scanner  
Print Date: January 1980  
Rev. and Date: ----

## C/E PAGE EFFECTIVITY

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| 14       | 3/82       |

CHANGE #1 - 13204, 13348

Rev.- D, -005 Accessory Bus Interface PCB Assembly (2300A-4050)

On page 602-6, add the following note below para. 602-34:

NOTE

Before performing this adjustment it is necessary to do -12.75V calibration procedure on page 608-8 para. 605-46c of options section see change errata.

On page 605-8, delete paragraph 605-46 and add the following:

605-46. 2300A/2190A Interface Adjustment

605-46a. When interfacing your 2300A with a Fluke 2190A Digital Thermometer, it is necessary to readjust the zero calibration of the 2190A. This adjustment is not sold as a factory because the 2190A and the 2300A are not sold as a system. Use the following procedure to accomplish this task.

1. Turn the 2190A and 2300A power off.
2. Remove the Thermocouple Input Assembly from the rear of the 2190A and ensure that the input terminals are open.
3. Place the 8 position (labeled on the PCB) of S1 to On and replace the Thermocouple Input Assembly into the 2190A.
4. Remove a Thermocouple Scanner card (Option -002) from the 2300A Scanner, short the input terminals for one of the channels and replace the Thermocouple Scanner Card into the 2300A.
5. Connect the 2300A interface option cable into the 2190A Accessory Connector on the rear of the 2190A.
6. Turn the 2190A and 2300A power on.
7. Set the 2300A to the channel which was shorted in step 4 above.
8. Set the 2300A channel delay to 0.0.
9. Turn the 2190A Zero potentiometer (located on the 2190A front panel, behind the screw-locked cover) to obtain a 2190A display of 0.0.
9. Adjust the 2190A and 2300A power off, remove the Thermocouple Input Assembly from the 2190A, place all switches of S1 off and replace the Thermocouple Input Assembly into the 2190A.

## NOTE

The 2190A zero will need to be readjusted if not being used with the 2300A. To readjust the 2190A zero, turn the 2190A power off, remove the Thermocouple Input Assembly, short the input terminals, repeat step 3 above, turn the 2190A power on, and repeat step 9 above.

## 605-46b. -12.75V Calibration Adjustment

605-46c. When interfacing your 2300A with a Fluke 2190A Digital Thermometer, the following adjustment must be completed to insure an accurate -12.75V supply. This adjustment is made at the factory and should not need to be done when you receive your 2300A. However, it should be checked during the normal calibration cycle.

1. Install the Thermocouple Scanner PCB Assembly -002 in a 2300A mainframe.
2. Connect the DMM test leads between TP1 (-) and the junction of R2 and R3 (+) on the -002 PCB.
3. Adjust R43 (located on the left front of the Interface -005 or -006 PCB) for a -12.75V DC indication on the DMM.
4. Perform the calibration adjustment for the -002 Option.

On page 606-15 delete paragraph 606-77 and add the following:

606-77a. When interfacing your 2300A with a Fluke 2190A Digital Thermometer, it is necessary to readjust the zero calibration of the 2190A. This adjustment is not done at the factory because the 2190A and the 2300A are not sold as a system. Use the following procedure to accomplish this task.

1. Turn the 2190A and 2300A power off.
2. Remove the Thermocouple Input Assembly from the rear of the 2190A and ensure that the input terminals are open.
3. Place the 8 switch (labeled on the PCB) of S1 on and replace the Thermocouple Input Assembly into the 2190A.
4. Remove a Thermocouple Scanner Card (Option -002) from the 2300A Scanner, short the input terminals for one of the channels, and replace the Thermocouple Scanner Card into the 2300A.
5. Connect the 2300A interface option cable into the 2190A Accessory Connector on the rear of the 2190A.



6. Turn the 2190A and 2300A power on.
7. Set the 2300A to the channel which was shorted in step 4 above.
8. Set the 2300A channel delay to 0.0.
9. Adjust the 2190A Zero potentiometer (located on the 2190A front panel, behind the screw-locked cover) to obtain a 2190A display of 0.0.
10. Turn the 2190A and 2300A power off, remove the Thermocouple Input Assembly from the 2190A, place all switches of S1 off and replace the Thermocouple Input Assembly into the 2190A.

## NOTE

The 2190A zero will need to be readjusted if not being used with the 2300A. To readjust the 2190A zero, turn the 2190A power off, remove the Thermocouple Input Assembly, short the input terminals, repeat step 3 above, turn the 2190A power on, and repeat step 9 above.

## 606-77b. -12.75V Calibration Adjustment

606-77c. When interfacing you 2300A with a Fluke 2190A Digital Thermometer, the following adjustment must be completed to insure an accurate -12.75V supply. This adjustment is made at the factory and should not need to be done when you receive your 2300A. However, it should be checked during the normal calibration cycle.

1. Install the Thermocouple Scanner PCB Assembly -002 in a 2300A mainframe.
2. Connect the DMM test leads between TP1 (-) and the junction of R2 and R3 (+) on the -002 PCB.
3. Adjust R43 (located on the left front of the Interface -05 or -06 PCB) for a -12.75V DC indication on the DMM.
4. Perform the calibration adjustment for the -002 Option.

On page 605-10 and 606-17:

Change the TOT QTY of R7, FROM: 7, TO: 3.  
Change the TOT QTY of R6, FROM: 4, TO: 8.

CHANGE: R15|Res, Dep. Car, 100K  $\pm 5\%$ , 1/4W|348920|80031|CR251-1-5P100K|RE  
TO: R15|Res, Dep. Car, 10K  $\pm 5\%$ , 1/4W|348839|80031|CR251-1-5P10K|REF

CHANGE: R16|Res, Dep. Car, 100K  $\pm 5\%$ , 1/4W|348920|80031|CR251-1-5P100K|REF  
 TO: R16|Res, Dep. Car, 10K  $\pm 5\%$ , 1/4W|348839|80031|CR251-1-5P10K|REF

CHANGE: R17|Res, Dep. Car, 100K  $\pm 5\%$ , 1/4W|348920|80031|CR251-1-5P100K|REF  
 TO: R17|Res, Dep. Car, 10K  $\pm 5\%$ , 1/4W|348839|80031|CR251-1-5P10K|REF

CHANGE: R22|Res, Dep. Car, 100K  $\pm 5\%$ , 1/4W|348920|80031|CR251-1-5P100K|REF  
 TO: R22|Res, Dep. Car, 10K  $\pm 5\%$ , 1/4W|348839|80031|CR251-1-5P10K|REF

ADD: C6|Cap, Ta, 2.2 UF, 35V|485185|56289|196D225X0035KA1|1

ADD: C7|Cap, Ta, 1 UF, 35V|161919|56289|196D105X0020JA1|1

On page 605-11 and 606-18:

ADD: R43|Res, Var. 100  $\pm 10\%$ , 1/4W|326116|89536|326116|1

ADD: R44|Res, comp, 750  $\pm 5\%$ , 1/4W|218024|01121|CB7515|1

ADD: U28|IC, Lin, Neg Volt Reg, Fixed Voltages|381665|04713|MC7912CT|1

CHANGE: U22|IC, OP. Amp, Dual|414284|12040|LM1458N|1|1

TO: U22|IC, Quad Line Driver|414052|12040|LM1488|1|1

On page 605-12 and 606-19/20:

R43 is shown in the upper left hand corner of the PCB (covering the static awareness caution).

C6 is shown directly beneath R43 with its + symbol between R43 and C6.

R44 is shown directly beneath C6.

U28 is shown just to the left of R44.

C7 is shown between the top of the PCB and P2.

On page 8-5, change J3/8 and J1/6:

FROM: S-I/08

TO: -12.75V

DELETE: (RJV/DIG. COM.)

On page 8-7, change J9A/11 and J9B/11:

FROM: S-I/08

TO: -12.75V

DELETE: (RJV/DIG. COM.)

On page 8-9, change P9/11:

FROM: RJV(S-1/08)

TO: -12.75V

On page 8-13:

Change the value of R15, R16, R17 and R22:

FROM: 100K, TO: 10K.

On page 8-13, revise the schematic as shown in Figure 1.

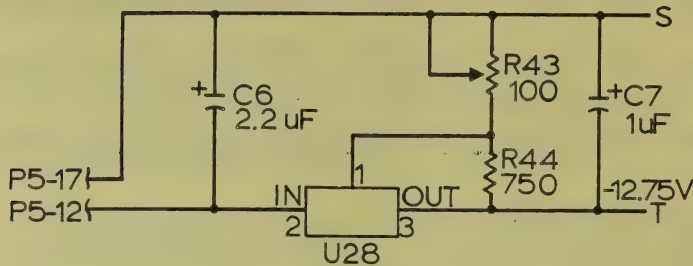


Figure 1.

On page 8-14, change P2/8:

FROM: S-I/08

TO: -12.75V

DELETE: (RJV/DIG COM.)

CHANGE #2 - 13464

Rev.- C, -002 Thermocouple Scanner PCB Assy. (2300A-4020)

On page 602-9:

DELETE: MP9|Grommet|519827|83014|HN4G-43-5|2

DELETE: MP13|Plunger|519835|89536|519835|2

CHANGE: H3|Screw, PHP, 4-40 X 1/2|521132|89536|521132|3

TO: H3|Screw, PHP, 4-40 X 5/8|145813|73734|19027|3

CHANGE #3 - 13540

Rev.- G, -005 Accessory Bus Interface PCB Assy. (2300A-4020)

On page 605-11 and 606-18:

CHANGE: U2|IC, Opto-Isolator|380014|01295|T1L116|6|2

TO: U2|IC, Opto-Isolator|536045|14936|MCT-26|6|2

CHANGE: U3|IC, Opto-Isolator|380014|01295|T1L116|REF

TO: U3|IC, Opto-Isolator|536045|14936|MCT-26|REF

CHANGE: U4|IC, Opto-Isolator|380014|01295|T1L116|REF

TO: U4|IC, Opto-Isolator|536045|12936|MCT-26|REF

CHANGE: U5|IC, Opto-Isolator|380014|01295|T1L116|REF

TO: U5|IC, Opto-Isolator|536045|12936|MCT-26|REF

CHANGE: U6|IC, Opto-Isolator|380014|01295|T1L116|REF

TO: U6|IC, Opto-Isolator|536045|12936|MCT-26|REF

CHANGE: U7|IC, Opto-Isolator|380014|01295|T1L116|REF

TO: U7|IC, Opto-Isolator|536045|12936|MCT-26|REF



## ERRATA #1

On page 2-2, para. 2-12 add the following to the end of step 5:

"Refer to option information in section 6 for additional operating notes and calibration information."

On page 2-5, para. 2-27; page 605-2 para. 605-8; page 606-2 para. 606-11, add the following note between the heading and the text:

## NOTE

Before operating the 2300A with a digital thermometer, refer to the Operation and Calibration Information in section 6 for the Interface Option.

On page 2-4, Table 2-1 item 15, under FUNCTION:

CHANGE: Connector for external DC supply.

TO: Connector for external DC supply (+ terminal is on the left nearest to item 16).

On page 6-1, under ACCESSORIES:

ADD: P.C.B. Extender Cables.....600-1

On page 6-2, add the following paragraph and caution:

#### 6-8. Options -005 and -006

6-9. Currently the 2300A is sold with either option, -005 or -006 (remote control) installed. The difference between the options are the two microprocessors, one on the Scanner Control Assembly (lower PCB) and one on the Accessory Bus Interface Assembly. To upgrade the Option -005 to an Option -006 it is necessary to replace the microprocessors (U4 and U20) and the EPROMs (U4A and U20A) only, you do not need to order the complete option. See CHANGE #2 of this Change/Errata for Fluke part Numbers.

#### CAUTION!

THE MICROPROCESSORS ARE STATIC SENSITIVE DEVICES. WE RECOMMEND THAT YOU CONTACT YOUR NEAREST FLUKE SERVICE CENTER FOR INSTALLATION ASSISTANCE.

On page 600-1:

ADD: 600-6a. P.C.B. Extender Cables

600-6b. Two P.C.B. Extender Cables are available as service aids. They can be obtained by ordering; John Fluke P/N: 53220, (for the 18 conductor, 16" long cable).

On page 602-1, replace the 2<sup>nd</sup> sentence of the NOTE with following:

"Upon power up your thermometer should display 9004.1 for type 1 software, 9005.2 for type 2 or 9005.3 for type 3 (see Table 602-2). The digits to the left of the decimal point are the software version number, while the digit to the right represents the thermocouple linearization. If a higher version number is displayed the software is valid, however if a lower number is displayed you must update the software before operating the thermometer with the Scanner. Please contact your nearest Fluke Service Center."

On page 602-2, bottom of Figure 602-1:

The Thermocouple is shown connected backwards. The TC+ line should go to "H", while the TC- line should go to "L".

On page 603-1, change the fourth line of the NOTE:

FROM: ... up, your thermometer displays 2180.1, the...

TO: ... up, your thermometer displays value lower than 8002.2, the...

On page 605-2, Table 605-2:

CHANGE: 1 1 1 2 1 3 1 4 1

TO: 1 4 1 3 1 2 1 1 1

On page 605-2, para. 605-9 and page 606-2, para 606-11 add the following note between the heading and the text:

#### NOTE

When operating the 2300A with the 1120A IEEE Bus Translator or an RS-232C compatible device, the 2300A must be set for the baud rate required by the device.

On page 605-2 add the following paragraph and Table labeled 605-7a and 605-1a respectively. On page 606-2 add the same paragraph and table as just described, but label them 606-9a and 606-1a respectively.

#### PTI Interface Connector

A male PTI interface connector, (PA) is available (see CHANGE #2) to mate to J8 on the -005 or -006 Interface Assembly. It allows you to construct your own cable to interface the 2300A to an RE-232-C compatible device. When constructing the connector, refer to the following table and the schematics in Section 8.

Table \_\_\_\_\_ RS-232-C INTERFACE SIGNALS

| PIN | NAME                 | DIRECTION | OPERATION                                                                                                                                       |
|-----|----------------------|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 30  | Transmitted Data     | Out       | Data sent from the Scanner to an external device.                                                                                               |
| 26  | Received Data        | In        | Data sent from an external device to the Scanner (-006 Option only).                                                                            |
| 28  | Scanner Busy         | Out       | The Scanner sets Scanner Busy low when it is unable to receive.                                                                                 |
| 34  | Signal Common        | ----      | -----                                                                                                                                           |
| 32  | Clear to Send        | In        | If an external device pulls CTS low, the 2300A stops communicating. Leaving CTS open or pulling it up allows the 2300A to resume communication. |
| 27  | Received Line Signal | In        | If an external device pulls RLS low, the 2300A stops communicating. Leaving RLS open or pulling it up allows the 2300A to resume communication. |
| 31  | Request to Send      | Out       | The 2300A always pulls RTS up to +12V.                                                                                                          |
| 29  | Data Terminal        | Out       | The 2300A always pulls DTR up to +12V.                                                                                                          |
| 35  | TTY Current Loop (+) |           | The 2300A supplies 20 milliamp current loop levels. No remote programming via current loop is possible (RS-232-C current loop output only).     |
| 36  | TTY Currrent         |           |                                                                                                                                                 |

On page 606-1, add the following note between para. 606-7 and 606-8:

## NOTE

The RS-232-C interface is not active when the 2300A is powered from the 12V DC rear panel inputs.

On page 606-2, Table 606-2:

CHANGE: 1 1 1 2 1 4 1 8 1

TO: 1 4 1 3 1 2 1 1 1

On page 606-3, Table 606-3:

DELETE: All asterisks (\*).

DELETE: \* Output Only



Table \_\_\_\_\_ RS-232-C INTERFACE SIGNALS

| PIN | NAME                 | DIRECTION | OPERATION                                                                                                                                       |
|-----|----------------------|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 30  | Transmitted Data     | Out       | Data sent from the Scanner to an external device.                                                                                               |
| 26  | Received Data        | In        | Data sent from an external device to the Scanner (-006 Option only).                                                                            |
| 28  | Scanner Busy         | Out       | The Scanner sets Scanner Busy low when it is unable to receive.                                                                                 |
| 34  | Signal Common        | ----      | -----                                                                                                                                           |
| 32  | Clear to Send        | In        | If an external device pulls CTS low, the 2300A stops communicating. Leaving CTS open or pulling it up allows the 2300A to resume communication. |
| 27  | Received Line Signal | In        | If an external device pulls RLS low, the 2300A stops communicating. Leaving RLS open or pulling it up allows the 2300A to resume communication. |
| 31  | Request to Send      | Out       | The 2300A always pulls RTS up to +12V.                                                                                                          |
| 29  | Data Terminal        | Out       | The 2300A always pulls DTR up to +12V.                                                                                                          |
| 35  | TTY Current Loop (+) |           | The 2300A supplies 20 milliamp current loop levels. No remote programming via current loop is possible (RS-232-C current loop output only).     |
| 36  | TTY Currrent         |           |                                                                                                                                                 |

On page 606-1, add the following note between para. 606-7 and 606-8:

## NOTE

The RS-232-C interface is not active when the 2300A is powered from the 12V DC rear panel inputs.

On page 606-2, Table 606-2:

CHANGE: 1 1 2 4 8 1

TO: 1 4 3 2 1 1

On page 606-3, Table 606-3:

DELETE: All asterisks (\*).

DELETE: \* Output Only

ADD: 606-18a. The 2300A may also operate in echo or non-echo mode. In echo mode (segment 4 of the interface assembly switch S1 is On), the 2300A echos to the controlling device each character it receives. When the controller sends an escape code, the 2300A echos an escape and a carriage return/line feed. Additionally, when the controller sends a carriage return, the 2300A echos carriage return and line feed. In non-echo mode (segment 4 of S1 is OFF) there is no echo.

606-18b. In order for the 2300A to communicate properly with the controlling device at computer speeds, its "Scanner Busy" signal line must be connected to the controller's signal line which is designed to prevent the controller from sending data (such as Clear-to-Send or Data-Set-Ready). This prevents the controller from sending commands faster than the 2300A can accept them.

On page 606-4:

Add the following paragraph to the end para. 606-20:

In command and auto mode the scanner continues auto scanning, although it does not output data. However, it sends acknowledgements to commands. When commanded to return to monitor mode, the scanner immediately begins sending readings to the controller from the current channel.

#### NOTE

Reading rate is determined by both the programmed channel delay and the selected baud rate.

Replace the first sentence of para. 606-21 with the following:

All of the commands listed in Table 606-4 except ESC must be followed by a carriage return but no line feed. If the commands are followed by a carriage return and a line feed, the commands will be accepted, but the Scanner will issue a SYNTAX ERROR message. Up to 15 characters may be sent in a command string; however, the Scanner will ignore all but the command characters sent just prior to the carriage return. Upon receipt of the carriage return, the Scanner interprets and acknowledges the command. For all but the ESC and print commands (AP, RP, etc.), the acknowledgement is a set of characters consisting of; space, carriage return and line feed. See Table 606-4b for acknowledgement output format.

## CHANGE #4 - 13880.

On page 605-11:

ADD: U20|IC, DIGITAL, MICROPROCESSOR|535310|89536|535310|REF  
 ADD: PA|CONN, PTI INTERFACE|158451|89536|158451|1  
 (For external cable)

On page 606-18:

CHANGE: U20|IC, MICRO-PROCESSOR|508424|89536|508424|1|1  
 TO: U20|IC, DIGITAL, MICROPROCESSOR|535310|89536|535310|REF

On page 605-11 and 606-18:

CHANGE: U4|IC, OPTO-ISOLATOR|380014|01295|T1L116|REF  
 TO: U4|IC, MICROPROCESSOR|535310|89536|535310|2|1

ADD: U20A|IC, EPROM|581702|89536|581702|1

ADD: U4A|IC, EPROM|541060|89536|541060|1

## ERRATA #2

On page 606-4, replace paragraph 606-19 with the following:

606-19. An Escape character (hex "1B" or decimal 27) without a carriage return or line feed is required to switch the interface from a command mode to a monitor mode. Assuming the system is in the command mode, the operator can enter a command character string. When the Remote Control Interface has accepted the command, it sends a space, or carriage return, and a line feed character to inform the controller that the command has been accepted. The scanner will execute the command immediately, but no data is sent to the controller until the operator enters another Escape character. The Escape character places the interface in an output mode, so it can supply data for the controller to monitor. If the controller is in the monitor mode, an Escape character must be entered to place the interface in a command mode. The Escape character, in effect, toggles the interface between command and monitor modes. If the interface is in the command mode, it sends a question mark (?) with a carriage return and line feed to the controller, indicating that it is awaiting



On page 605-2 and 606-4, add the following Table to each Operating Instructions:

Measurement Data Output Format for  
RS-232-C and Current Loop Ports

|                          |    |    |    |    |   |   |   |   |    |    |    |    |    |    |     |     |    |    |    |
|--------------------------|----|----|----|----|---|---|---|---|----|----|----|----|----|----|-----|-----|----|----|----|
| 1                        | 2  | 3  | 4  | 5  | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16  | 17  | 18 | 19 |    |
| NORMAL OUTPUT            |    |    |    |    |   |   |   |   |    |    |    |    |    |    |     |     |    |    |    |
| CH                       | CH | SP | SP | SP | ± | D | D | D | D  | D  | D  | D  | SP | SP | SP  | F/C | SP | CR | LF |
| OPEN THERMOCOUPLE OUTPUT |    |    |    |    |   |   |   |   |    |    |    |    |    |    |     |     |    |    |    |
| CH                       | CH | SP | SP | SP | ± | D | D | D | D  | D  | D  | ?  | SP | SP | F/C | O   | T  | CR | LF |
| OVERRANGE OUTPUT         |    |    |    |    |   |   |   |   |    |    |    |    |    |    |     |     |    |    |    |
| CH                       | CH | SP | SP | SP | ± | D | D | D | D  | D  | D  | D  | SP | SP | F/C | O   | R  | CR | LF |

NOTE: If the limits option in the thermometer is installed (option 21X0A-006) and is indicating a limit condition, character slot 4 will be an exclamation point (!) for any of the three above modes.

SYMBOL DESCRIPTION

|     |                                                                                                                                                                       |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CH  | Channel Identification numbers (00 thru 99)                                                                                                                           |
| SP  | Space                                                                                                                                                                 |
| !   | Thermometer limits Option Setpoint exceeded symbol                                                                                                                    |
| ±   | Plus or minus symbol                                                                                                                                                  |
| D   | Temperature data values (0 thru 9)                                                                                                                                    |
| .   | Floating decimal point, will be in character slots 11 or 12 when used with 2180A Thermometer, decimal point will be in character slot 12 with 2190A Thermometer resp. |
| F/C | Fahrenheit or Celsius                                                                                                                                                 |
| CR  | Carriage Return                                                                                                                                                       |
| LF  | Line Feed                                                                                                                                                             |
| ?   | Question mark                                                                                                                                                         |
| OT  | Open Thermocouple (Character slots 16 and 17)                                                                                                                         |
| OR  | Over Range (Character slots 16 and 17)                                                                                                                                |

On page 606-4, add Table 606-4a:

Table 606-4a Command Response Output Format for RS-232-C Port

| INPUT COMMAND    | 1  | 2  | 3  | 4 | 5  | 6  | 7  | 8  | 9 | 10 | 11 | 12 | 13 | 14 |
|------------------|----|----|----|---|----|----|----|----|---|----|----|----|----|----|
| Escape           | ?  | CR | LF |   |    |    |    |    |   |    |    |    |    |    |
| R,L,D,S,U,M,A, X | SP | CR | LF |   |    |    |    |    |   |    |    |    |    |    |
| RP (Auto Mode)   | A  | U  | T  | O | SP | M  | O  | D  | E | CR | LF |    |    |    |
| RP (Manual Mode) | M  | A  | N  | U | A  | L  | SP | M  | O | D  | E  | CR | LF |    |
| MP               | C  | H  | A  | N | N  | E  | L  | SP | = | SP | n  | n  | CR | LF |
| AP or XP         | S  | C  | A  | N | SP | n  | n  | -  | m | m  | CR | LF |    |    |
| DP               | D  | E  | L  | A | Y  | SP | =  | SP | n | .  | n  | CR | LF |    |

On page 605-2, para. 605-11 and page 606-2, para. 606-13 add the following to each paragraph:

"When using the RS-232-C interface, set the address switches to address 1, 6, 7, 8, or 9."

On page 605-2, para. 605-12 and page 606-2, para. 606-15 add the following to each paragraph:

"When using the 2XXXA-522 Personality Card and the 1120A IEEE-488 Translator, set the baud rate to 2400 and follow all details regarding the RS-232-C interface."

On page 606-5, after para. 606-24 add the following Programming Notes:

1. Basic Controllers, such as the Fluke 1720A use the "CHR\$ (27);" command to send the Escape character without the carriage return and line feed characters.
2. The question mark (?), carriage return and line feed characters maybe preceded by the 19 measurement data characters previously generated by the Thermometer before the Escape character was received.
3. The Escape character, when received by the 2300A-006, does not stop the thermometer from scanning, only printing it.
4. The thermometer will continue to finish making an answer on the channel it is selected to before it will respond to a new command.
5. Each command reponse is delayed by up to 300 milliseconds for the thermometer to complete its measurement it is working on plus the delay time that is programmed. The programmed delay time should be 2.0 seconds when used with the 2190A or 2180A thermometer for acheiving rated accuracy.
6. It is suggested that after sending the escape character to place the 2300A in the command mode, reading should be taken until ? CR LF is found. Further, after each command is given a reading should be taken to drain the output buffer of the 2300A.
7. An easy way to look for the ?CR LF response in basic is to set your string variable equal to a question mark (STRING = ?).

8. Use of the Single Scan Command: If the thermometer is on channel 0 and a "X04-06 CR", ESC, command is entered, the 2300A-006 will output channels 0, 1, 2, 3, 4, 5, 6, 4, 4, 4, 4, ... in that order. If the thermometer is on channel 5 when "X04-06 CR", ESC, is received, the 2300A-006 will output channels 5, 6, 4, 4, 4, 4, etc. If the thermometer is on channel 8 when "X04-06 CR", ESC, is received, the 2300A-006 will output channel 8 then 9, 4, 5, 6, 4, 4, 4, 4, etc. Entering a monitor command of "M04 CR" prior to entering "X04-06 CR" will yield an output of 4, 4, 5, 6, 4, 4, 4, 4, etc.

CHANGE #5 - 15482

Rev.- D, -002 Thermocouple Scanner PCB Assembly (2300A-4020)

On page 8-9, remove pin 6 designation from connector P9.

CHANGE #6 - 15483

Rev.- F, -005 Accessory Bus Interface PCB Assembly (2300A-4050)

On page 8-13 and 8-14, lower left quadrant:

CHANGE: Pin 3, 15 TC-/A.COM

TO: Pin 3 TC-





## 2-25. Operating Modes

2-26. Three operating modes are possible with the Model 2300A Scanner Mainframe: manual, automatic, and remote. In the manual mode, the operator increments the scanner through the channels using the UP and DN switches. Each channel may be monitored for any time period the operator wishes, since he is in direct control of the scan. In automatic operation, the scanner increments through the channels automatically, skipping those channels the operator has programmed to be skipped. Remote operation is available only with certain interface options installed. In remote operation, a remote device can control the scanner operation, including channel delay times and skip programming. Refer to Section 6 of this manual for specific information about each interface option.

## 2-27. OPERATING NOTES

2-28. The following paragraphs describe various conditions that could effect 2300A Scanner Mainframe operation. They also describe minor, operator-performed, periodic maintenance procedures. The operator should be familiar with these conditions and procedures prior to operating the 2300A Scanner Mainframe.

## 2-29. Fuse Replacement

2-30. The ac line input and external dc input are individually fuse protected. Both fuses are readily accessible from the outside of the rear panel. The ac line input fuse (F1) should be replaced with a 1/8 ampere, slow-blow fuse if the 100 to 130V ac input range is used; the replacement fuse should be a 1/16 ampere, slow-blow if the 200 to 260V ac range is used. The external dc input fuse (F2) requires a 3/4 ampere, slow-blow replacement. Refer to Section 4 for fuse replacement procedures.

## 2-31. Line Voltage Selection

2-32. Two ac line voltage input ranges are switch selectable in the Model 2300A Scanner Mainframe: 100V to 130V ac and 200V to 260V ac. The line voltage select switch is located on the Scanner Control pcb inside the Scanner Mainframe case. The input voltage range initially selected at the factory is marked on the placard on the rear panel. Instructions for changing the line voltage switch setting are located in Section 4 of this manual.

## 2-33. OPERATION

2-34. Use the following procedure to program and operate the 2300A Scanner Mainframe:

1. Install the 2300A as detailed in the Installation Instructions.
2. Install the interface option and scanner board options as detailed in the appropriate part of Section 6 of this manual.
3. Connect the necessary power to all instruments.
4. Press the POWER switch.
5. Press the MANUAL switch to establish manual operating mode.
6. Establish the desired channel delay time.
7. Select the skip function for the channels to be skipped.
8. Scan channels as required using MANUAL, AUTO, or REMOTE operation.





## Section 3

# Theory of Operation

### 3-1. INTRODUCTION

3-2. This section of the manual contains an overall functional description followed by a circuit analysis of the Model 2300A Scanner Mainframe. Block diagrams and simplified circuit diagrams are provided, as necessary, to supplement the text. Detailed schematics are available in Section 8 of this manual.

### 3-3. OVERALL FUNCTIONAL DESCRIPTION

3-4. Circuitry within the 2300A Scanner Mainframe accepts analog signals and supplies them, in sequence, to a measurement/test instrument. The test instrument displays the information it receives from the scanner. Scanner Mainframe circuitry is configured in two pcbs: the Scanner Control PCB, and the Display/Keyboard PCB. An optional interface pcb and a scanner pcb are required for operation. Optional interface and scanner pcb information is located in Section 6 of this manual under the appropriate interface or scanner option heading.

3-5. The Scanner Control PCB contains all 2300A control and power supply circuitry. Control circuitry consists primarily of a microcomputer, with the necessary buffers. The Scanner Control PCB acts as the scanner system controller. It controls bidirectional communication with the Display/Keyboard, the interface card, and all scanner extenders. It sends information to, and receives information from, all other system components. Power supply circuitry on the Scanner Control PCB accepts either an ac or dc input, and it produces three operating voltages: positive 5V dc, positive 12V dc, and negative 12V dc. The three voltages supply power to all other components in the 2300A Scanner Mainframe. Functional sections of the 2300A are shown in Figure 3-1.

3-6. Operator controls and front panel indicators are mounted on the Display/Keyboard PCB. Controls on the Display/Keyboard PCB allow operator entry of channel skip selection and channel delay time. Push-button switches allow the operator to select manual or automatic scan operation, and increment or decrement through the scanner channels. Light emitting diodes (LED) on the Display/Keyboard PCB provide a channel number display or channel delay time display, and they indicate the skip condition of each channel and the operating mode.

3-7. All Display/Keyboard PCB functions are controlled by the microcomputer on the Scanner Control PCB. Communication between the Display/Keyboard PCB and the Scanner Control PCB is through an internal, bidirectional data bus. All operator entries from the front panel controls are routed to the Scanner Control PCB, then processed in the microcomputer, and the proper control signals are sent to the indicators using the internal bus lines. The Display/Keyboard PCB contains driver circuits for the LEDs, in addition to the LEDs and switches.

### 3-8. BLOCK DIAGRAM ANALYSIS

### 3-9. Scanner Control PCB

3-10. All 2300A Scanner Mainframe program and control capabilities reside in the scanner control microcomputer. The scanner control microcomputer communicates with Display/Keyboard circuitry, the scanner card option, the interface option, and all Model 2301A Scanner Extenders in the system. Communication with the interface option and scanner extenders is through the bidirectional serial bus structure. Refer to Figure 3-2, Scanner Control Block Diagram.

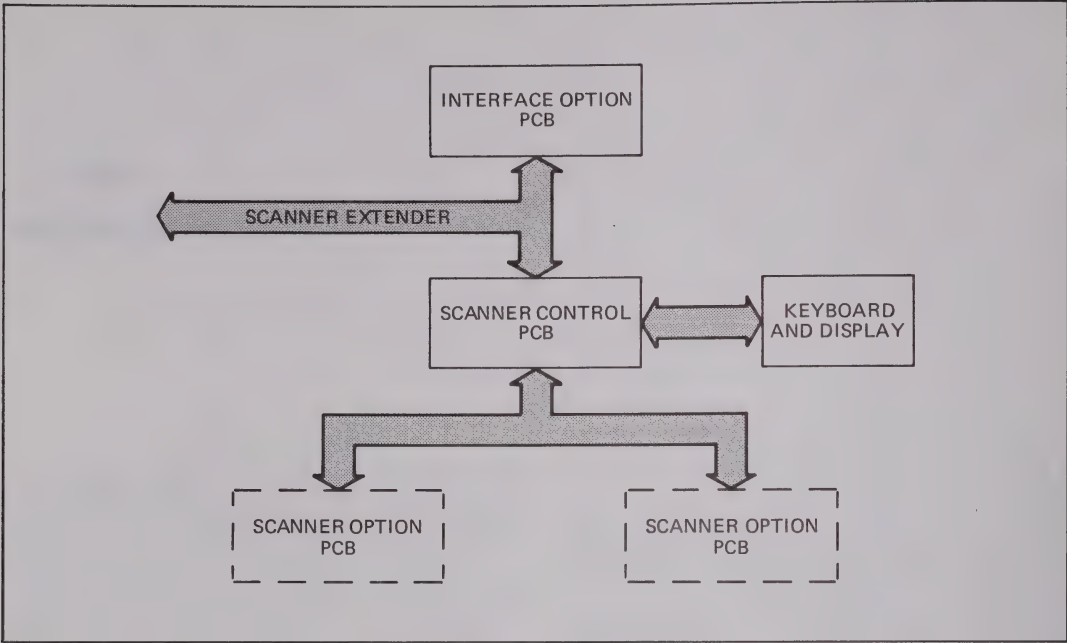


Figure 3-1. Functional Block Diagram

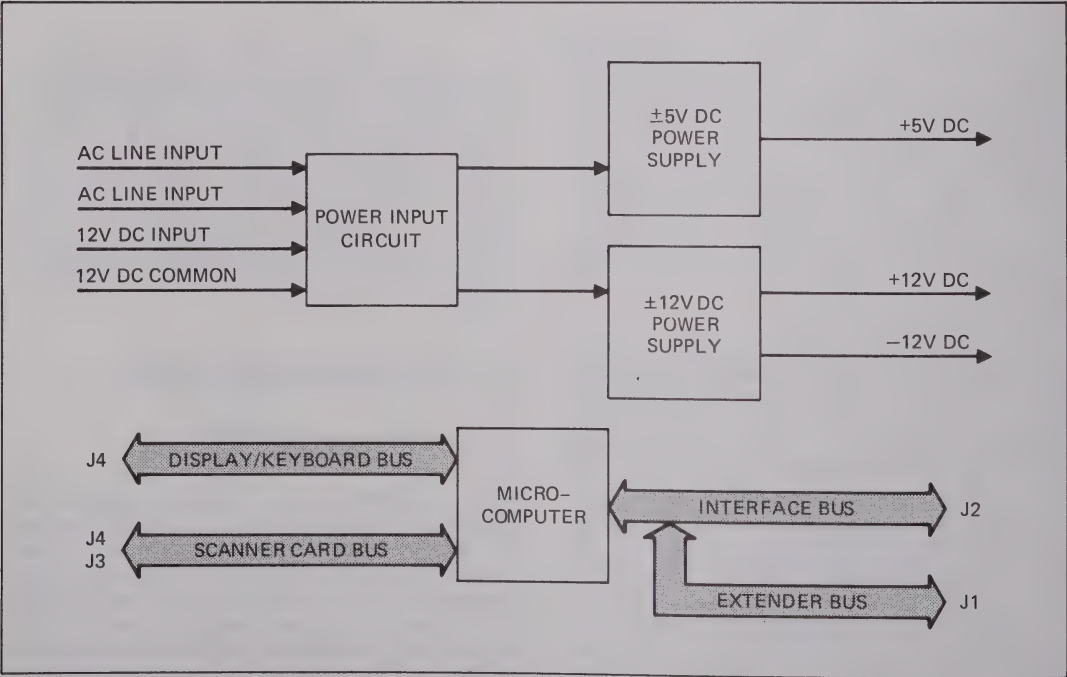


Figure 3-2. Scanner Control Block Diagram

3-11. As can be seen in the block diagram, the microcomputer communicates with the Display/Keyboard circuitry through connector J4, with the scanner Card circuitry through connectors J3 and J4, with the interface circuitry through connector J2, and with the

Scanner Extender through J1. All communication ports are bidirectional, although individual lines may be unidirectional. Connector pin usage for connectors J1 and J2 is listed in Table 3-1; pin usage for connector J3 is listed in Table 3-2; pin usage for connector J4 is listed in Table 3-3.

Table 3-1. Connector Pin Usage (J1, J2)

| J1*  | J2* | MNEMONIC                  | DESCRIPTION                         |
|------|-----|---------------------------|-------------------------------------|
| 1    | 1   | S-I/O 1                   | Signal Input/Output                 |
| 2,14 | 2   | S-I/O 2                   | Signal Input/Output                 |
| 3,15 | 3   | S-I/O 3                   | Signal Input/Output                 |
| 4,16 | 4   | S-I/O 4                   | Signal Input/Output                 |
| 5    | 6   | S-I/O 6                   | Signal Input/Output                 |
| 6    | 8   | S-I/O 8                   | Signal Input/Output                 |
| 9    | 11  | READY                     | Ready Response to Scanner Control   |
| 10   | 12  | ACK                       | Acknowledge to Scanner Control      |
| 11   | 13  | $\overline{\text{DVL}}$   | Data Valid                          |
| 12   | 14  | DATA FROM                 | Serial Data from Scanner Control    |
| 13   | 19  | +5                        | Positive 5V dc                      |
|      | 16  | +12                       | Positive 12V dc                     |
|      | 17  | -12                       | Negative 12V dc                     |
| 17   | 5   | S-I/O 5                   | Signal Input/Output                 |
| 18   | 7   | S-I/O 7                   | Signal Input/Output                 |
| 21   | 18  | RE                        | Relay Enable                        |
| 22   | 21  | $\overline{\text{RESET}}$ | Microcomputer Reset                 |
| 23   |     | $\overline{\text{NUDGE}}$ | Initialization Command to Extenders |
| 24   | 15  | DATA TO                   | Serial Data to Scanner Control      |
| 25   | 20  | GND                       | Power Common                        |

\*J1 = Extender Connector      \*J2 = Interface Connector

Table 3-2. Connector Pin Usage (J3)

| J3* | MNEMONIC                 | DESCRIPTION         |
|-----|--------------------------|---------------------|
| 1   | S-I/O 1                  | Signal Input/Output |
| 2   | S-I/O 2                  | Signal Input/Output |
| 3   | S-I/O 3                  | Signal Input/Output |
| 4   | S-I/O 4                  | Signal Input/Output |
| 5   | S-I/O 5                  | Signal Input/Output |
| 6   | S-I/O 6                  | Signal Input/Output |
| 7   | S-I/O 7                  | Signal Input/Output |
| 8   | S-I/O 8                  | Signal Input/Output |
| 11  | $\overline{\text{SB}} 7$ | Selector Bus Bit 7  |
| 12  | $\overline{\text{SB}} 6$ | Selector Bus Bit 6  |
| 13  | $\overline{\text{SB}} 5$ | Selector Bus Bit 5  |
| 14  | $\overline{\text{SB}} 4$ | Selector Bus Bit 4  |
| 15  | $\overline{\text{SB}} 3$ | Selector Bus Bit 3  |
| 16  | $\overline{\text{SB}} 2$ | Selector Bus Bit 2  |
| 17  | $\overline{\text{SB}} 1$ | Selector Bus Bit 1  |
| 18  | $\overline{\text{SB}} 0$ | Selector Bus Bit 0  |
| 19  | $\overline{\text{SB}} 8$ | Selector Bus Bit 8  |
| 20  | $\overline{\text{SB}} 9$ | Selector Bus Bit 9  |
| 21  | +5V dc                   | Circuit Power       |
| 22  | GND                      | Power Common        |

\*J3 = Display/Keyboard Connector

Table 3-3. Connector Pin Usage (J4)

| J4* | MNEMONIC | DESCRIPTION          |
|-----|----------|----------------------|
| 1   | FE-A     | Function Enable (A)  |
| 2   | SE-A     | Skip Enable (A)      |
| 3   | RE-A     | Relay Enable (A)     |
| 4   | DP       | Decimal Point        |
| 5   | DS1      | Digit Strobe 1       |
| 6   | DS2      | Digit Strobe 2       |
| 7   | DS3      | Digit Strobe 3       |
| 8   | G SEG    | LED Segment G Enable |
| 9   | C SEG    | LED Segment C Enable |
| 10  | B SEG    | LED Segment B Enable |
| 11  | D SEG    | LED Segment D Enable |
| 12  | E SEG    | LED Segment E Enable |
| 13  | F SEG    | LED Segment F Enable |
| 14  | A SEG    | LED Segment A Enable |
| 15  | KYBS     | Keyboard Strobe      |
| 16  | FE-B     | Function Enable (B)  |
| 17  | SE-B     | Skip Enable (B)      |
| 18  | RE-B     | Relay Enable (B)     |

\*J4 = Display/Keyboard Connector

3-12. The scanner control microcomputer can both talk and listen through J1 and J2. Data is transferred serially on either the DATA FROM line (talking) or the DATA TO line (listening). A specific handshake data transfer sequence occurs for each data bit. From the microcomputer, identical data is transferred to the interface option and all scanner extenders, with the exception of the initialization signal to the scanner extenders. The interface does not receive the initialization (NUDGE) signal.

3-13. Upon initialization, the microcomputer issues an initialization signal (NUDGE) to the scanner extender. When the first scanner extender has received the first NUDGE signal, it responds with an 8-bit data word on the DATA TO line to inform the microcomputer that it has been initialized. The scanner control microcomputer then commands the first scanner extender, through the DATA FROM line, to issue a NUDGE to the second extender. If a second scanner extender is present, it responds, through the DATA TO line, by sending an 8-bit word acknowledging the NUDGE signal. When the microcomputer receives the second 8-bit data word, indicating a second extender is present and operating, it commands the second extender to issue a NUDGE to the third extender. If a third extender is present and responds with an 8-bit data word acknowledging the NUDGE, the scanner control microcomputer does not direct the third extender to issue an additional NUDGE. Since only three extenders may be connected to one Scanner Mainframe, an additional NUDGE is never required.

3-14. Data is transferred from the Scanner Control PCB microcomputer to the interface option or a scanner extender using a handshake data transfer mode. The transfer sequence starts with the microcomputer in an idle, or wait, state. Refer to Figure 3-3, the Data Out Transfer Sequence. In the wait state, the DATA TO line is held high, the DATA FROM line is held low, the Data Valid (DVL) line is held high, the Acknowledge (ACK) line is held low, and the Data Ready (RDY) line is held high. The microcomputer first places valid data on the DATA FROM line, then it sets the DVL line low to inform the interface option or scanner extender that valid data is available. After reading the data, the interface and scanner extender microcomputers set the ACK line High and the RDY line low. Upon receipt of the last ACK, the scanner control microcomputer removes data from the DATA FROM line, and removes the DVL signal by returning it high. The interface and scanner extenders then toggle the ACK and RDY lines, returning the lines to a wait state. The handshake sequence is repeated to transfer each valid data bit.

3-15. Data transfer from an interface option or scanner extender to the Scanner Control PCB microcomputer is

also accomplished using a handshake data transfer sequence. A data transfer to the microcomputer is initiated by the scanner control microcomputer; it sends an 8-bit data word on the DATA FROM line. The 8-bit data word address one extender or interface and requests it to reply. The scanner control microcomputer then goes to the listen state by placing both DVL and DATA FROM high, as shown in Figure 3-4. With the microcomputer in the listen state, the scanner extender, or the interface option that has been addressed, can transfer data to the Scanner Control PCB. After the talk command is transferred, the addressed scanner extender or interface option will pull the DATA TO line low, signifying that it is ready to reply. When the scanner control microcomputer receives a low logic level on the DATA TO line, it then pulls DVL low. Shortly after DVL is set low all extenders and interfaces not replying read the DATA FROM line (high), then release the ACK line, allowing it to go high, and pull the RDY line low. The replying extender or option places data on the DATA TO line, then releases the ACK line and allows it to go high. When the scanner control microcomputer sees ACK high and RDY low, it reads the DATA TO line, then sets DVL high. It also pulls DATA FROM low, indicating that it is not ready to receive an additional data bit. In response to the DVL high logic level, all unaddressed extenders, and the interface option (if it is unaddressed), release the RDY line, allowing it to go high, and pull ACK low. The extender or interface responding removes data from the DATA TO line and sets it high. It then releases the RDY line, allowing it to go high, and pulls ACK low, thereby re-entering the ready state. When the scanner control microcomputer is ready to receive the next data bit, it sets the DATA FROM line high and initiates another data bit handshake sequence. All data transfers are either single or multiple 8-bit data words.

3-16. Output signals from the scanner control microcomputer, through connector J3, provide direct control for each of the scanner channels within the scanner option card. Connector J3 is physically connected to the Display/Keyboard, as is connector J4. All scanner card bus control signals are routed through the Display/Keyboard to the scanner option card by way of J3; control signals to select which of the two scanner option cards the bus control signals effect are routed through J4, and the Display/Keyboard, to the scanner option card they control.

3-17. All scanner channel Selector Bus (SB0-SB9) signals are generated within the microcomputer. Each Selector Bus signal is sent out in sequence to the scanner option cards, and the option card enabled by the Relay Enable (RE) signal, the Function Enable (FE) signal, or the Skip Enable (SE) signal responds with data. Separate Function Enable, Skip Enable, and Relay Enable signals are routed to each of the two option cards installed in one 2300A Scanner Mainframe chassis.



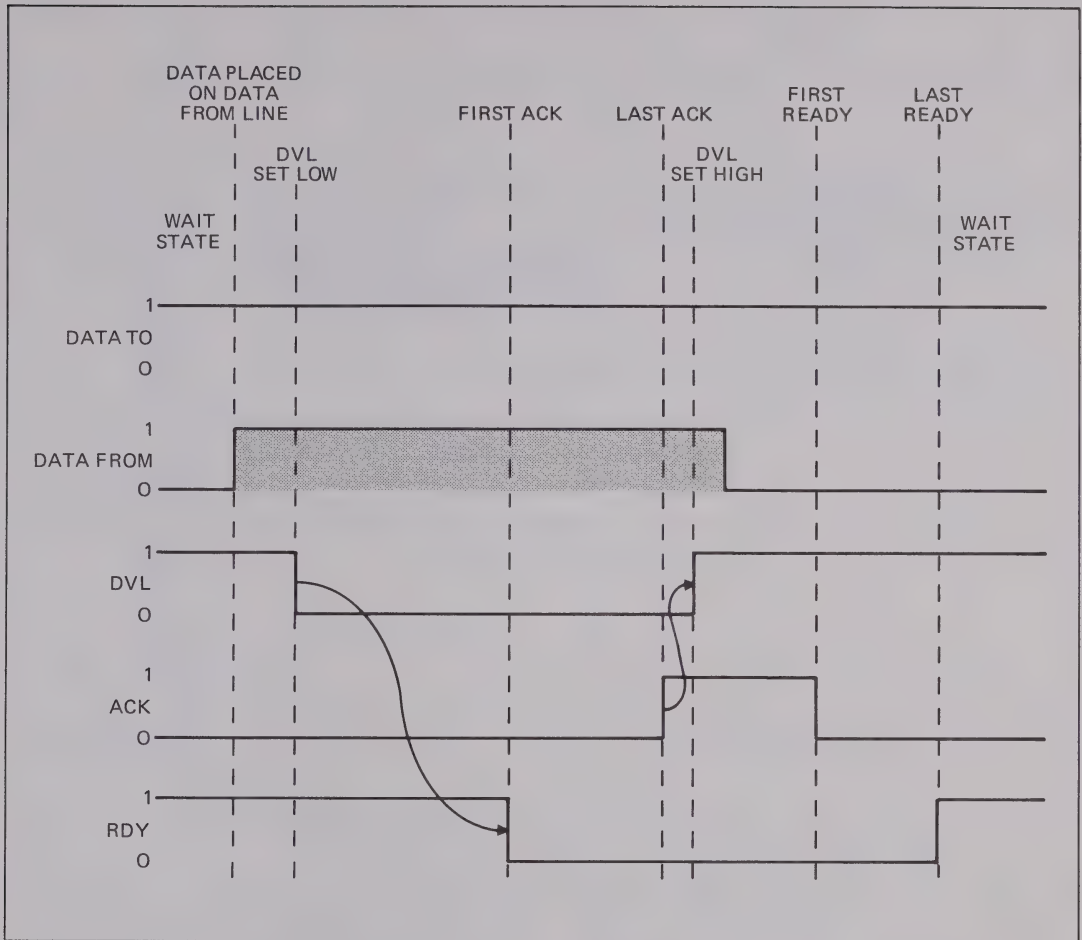


Figure 3-3. Data Out Transfer Sequence

3-18. Control signals for the scanner option cards are produced within the microcomputer through evaluation of data and control signals received from the front panel operator controls, or from the interface option card. Programming within the microcomputer determines how the information is interpreted to produce the necessary control signals. The microcomputer also receives data from each of the scanner channels, and interprets that data for output through the interface option and presentation to the front panel display. For additional information about the application of the microcomputer produced control signals, refer to the appropriate option in Section 6 of this manual.

3-19. Bidirectional communication between the microcomputer and the Display/Keyboard circuitry is

through connector J4. Control signals to light each segment of the front panel LEDs, and to enable each LED and the decimal point, are generated in the microcomputer from the data received. They are also read from the Display data lines when the Keyboard Strobe signal is true, enabling the keyboard switch inputs.

### 3-20. Keyboard and Display

3-21. Display/Keyboard circuitry also receives data and control signals from the Scanner Control PCB microcomputer and it sends operator input signals to the microcomputer. Figure 3-5, the Display/Keyboard Block Diagram, represents the functional circuit sections required to display information and generate operator input signals for the 2300A Scanner Mainframe.

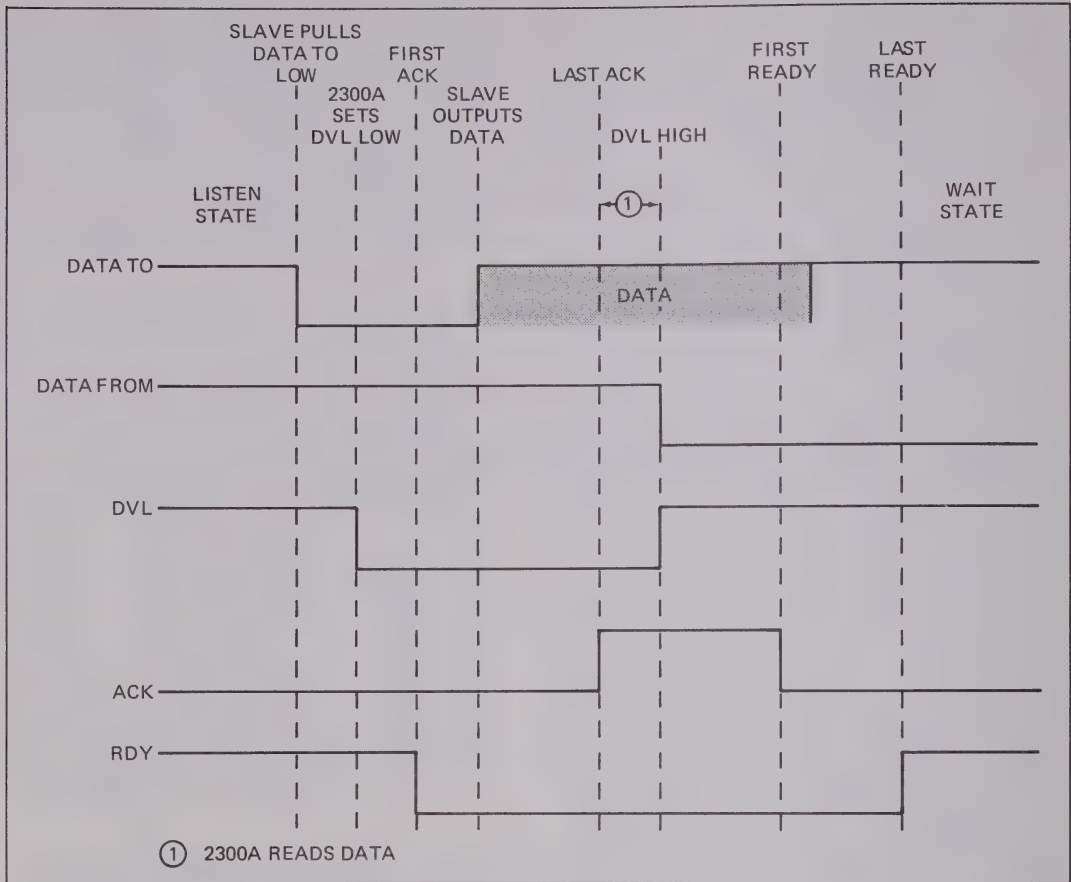


Figure 3-4. Data in Transfer Sequence

3-22. As shown in the Display/Keyboard PCB Block Diagram, there are three main groups of LEDs, and a group of operator entry switches. Each LED group and the operator entry switch group is controlled from the microcomputer by an unique enable signal. The DS 1 (Digit Strobe 1) signal controls all LEDs associated with the operator entry switches; the DS 2 signal controls the tens digit LED; and the DS 3 signal controls the units digit LED. The operator entry switches are controlled by the KYBS (Keyboard Strobe) control line. One additional control line (DP) is used to enable the decimal point when channel delay times are being programmed.

3-23. Each of the three LED control lines controls a transistor switch circuit. Each transistor switch circuit switches positive 5V dc to the appropriate LED or group of LEDs. The Decimal Point (DP) control line controls a transistor which switches common to the decimal point in the tens digit LED; the Keyboard Strobe (KYBS) signal

directly enables a group of six buffers which allow the keys, when pushed, to supply a ground level signal on each of the seven lines in the Segment Enable Bus.

3-24. The display consists of the two single-digit LED displays, the switch LEDs and lighted pushbuttons (treated as one additional digit LED), and the decimal point. Each of the four display units is strobed during one of four time periods, consisting of one millisecond each. The discrete LEDs and lighted pushbuttons are strobed during the first time period, and the Segment Enable lines supply data necessary to produce the proper lighted or unlighted condition for each LED or pushbutton. The two seven-segment, digit LEDs are strobed during the next two time periods, and the proper Segment Enable data is placed on the SE lines during that time. During the final time period, the decimal point is lighted if the 2300A is in the channel delay programming mode.

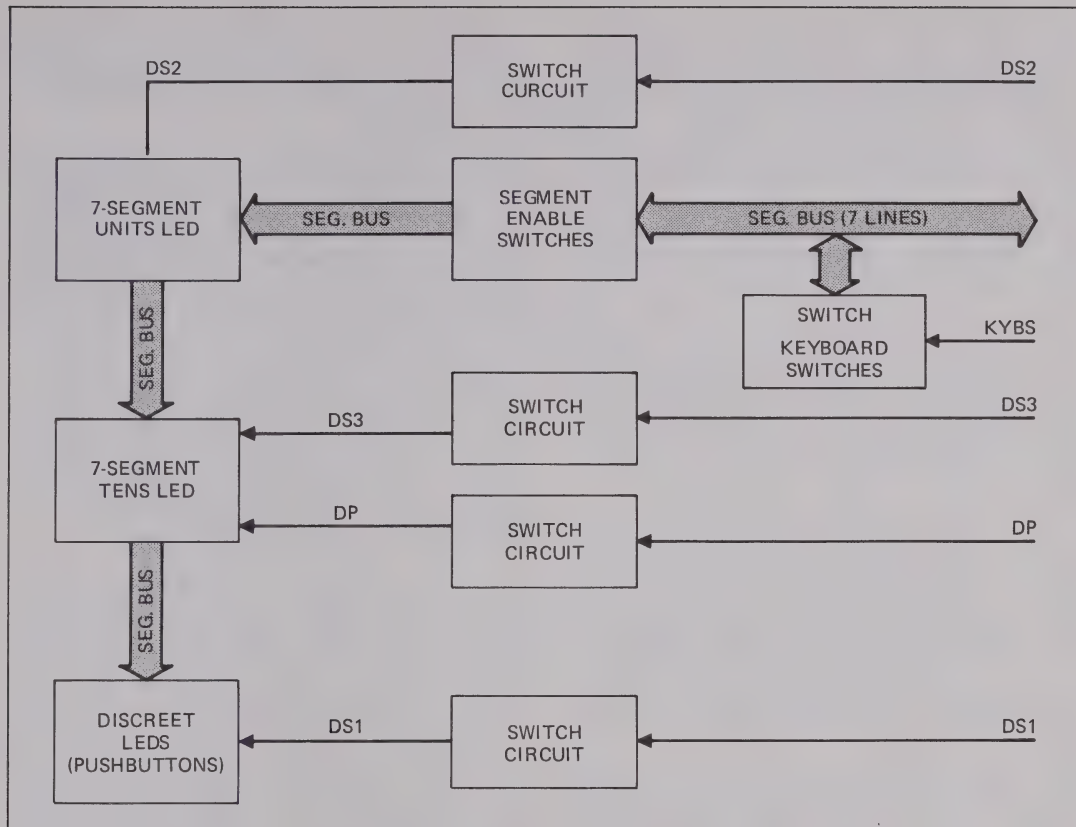


Figure 3-5. Display/Keyboard PCB Block Diagram

3-25. In the time period between LED strobes, the Keyboard is strobed and read. The scanner control microcomputer sets the Keyboard Strobe (KYBS) signal true and examines the state of the Segment Enable lines. At this time, any operator entered data from the front panel is transferred to the microcomputer and interpreted as necessary.

3-26. Additional bus lines within the Display/Keyboard PCB transfer data from the interface option board to the scanner option boards, and from the scanner option boards to the interface option. Six additional control lines from the Scanner Control PCB are also routed through the Display/Keyboard: Function Enable (FE) A and B, Skip Enable (SE) A and B, and Relay Enable (RE) A and B. These lines are used by the microcomputer to enable the selected relays on the scanner option pcbs, enable the scanner option pcb skip switches, and enable the scanner option pcb function switches. All data from the scanner option boards is read from or written onto the Selector Bus lines (SB0 through SB9).

### 3-27. Power Supply

3-28. All Scanner mainframe power supply circuitry is located on the Scanner Control PCB. Power supply circuitry requires one of three input voltages: 100V to 130V ac, 200V to 260V ac, or 10V to 15V dc. From either of the ac inputs, the power supply will produce three outputs: positive 5V dc, positive 12V dc, and negative 12V dc. The positive 5V dc output powers all scanner logic circuitry; the positive and negative 12V dc outputs are used in certain of the interface option boards for RS-232-C output functions. The 10V to 15V dc input does not supply power to the positive and negative 12V dc output circuits. Therefore, RS-232-C output functions are not available with dc input power.

3-29. Functionally, the 2300A power supply circuits may be divided into three sections: the power input circuit, the positive 5V dc circuit, and the positive and negative 12V dc circuit (see Figure 3-6). Input power is supplied to the input power circuit, and the input power

circuit supplies a dc voltage to the other two power supply circuits. Line voltage enters the input power circuit through a three-prong, u-ground connector. The ac input is fused, then switched through the Power Switch, and supplied to a transformer. The transformer is a dual-primary, dual-secondary type, with a switch installed on the primary circuit to select either series or parallel primary winding configurations. Switch selection at the primary allows the operator to select either 100V to 130V ac operation (primary windings in parallel) or 200V to 260V ac operation (primary windings in series).

3-30. Two bridge rectifiers at the transformer output convert the ac input voltage to a dc output. A Bridge rectifier provides input voltage for the positive 5V dc power supply circuit; a second bridge rectifier provides input voltage to the positive and negative 12V dc power supply circuit. Each bridge rectifier is operated from a separate secondary winding on the transformer.

3-31. The scanner mainframe will also operate from an external dc source. The source must supply between 10V and 15V dc through TBI on the 2300A Scanner Mainframe rear panel. External dc is fused (F1), then switched (S1) and routed through a diode to supply input power to the 5V dc power supply circuit. The external dc input does not supply power to the positive and negative 12V dc circuit, so those voltages are not present at the power supply outputs with external dc operation.

3-32. Refer to Figure 3-7, the Positive 5V dc Simplified Schematic. Input voltage, VA, supplied through either the transformer and bridge rectifier, or through the external dc terminal block, is controlled through a transistor switch circuit which, in turn, is controlled by a pulse width modulator (PWM). When the PWM turns the transistor switch on, the input voltage (VA) is supplied to an inductor. When the transistor switch is shut off, the energy developed in the inductor is supplied

to the load, and stored in a capacitor. Filtering components at the 5V power supply output provide a constant 5V dc output to the 2300A Scanner Mainframe logic components.

3-33. Output from the positive 5V dc power supply will remain stable with a wide variation of input voltages and current loads. The PWM varies the power supply duty cycle by varying the amount of time the transistor switch circuit is on. Output voltage, through a resistor scaling network, is routed to one input of a comparator circuit within the PWM. A regulated reference voltage is the other comparator input. When the scaled power supply output at the PWM comparator drops below the reference voltage input, the PWM increases the amount of time the transistor switch circuit remains on, thus increasing the voltage out. When the scaled power supply output rises above the reference voltage, the PWM internal circuitry decreases the amount of time the transistor switch remains on, thereby decreasing the output from the positive 5V dc power supply.

3-34. Four comparator circuits within the positive 5V dc power supply circuit provide reset and shutdown functions (refer to Figure 3-8). If the input voltage goes below operating level, the power supply shuts down. One comparator, with a scaled VA voltage at the non-inverting input and the reference voltage at the inverting input, generates an error signal for input to two additional comparators. One of the additional comparators uses the error output from the first comparator at the non-inverting input and the reference voltage at the inverting input. When the error input falls below the reference voltage, the comparator produces a Reset low logic signal which is used to reset the microcomputers throughout the scanner system. The same initial error signal, through an additional comparator used as an inverter, generates a positive shutdown input to the PWM in the 5V dc power supply.

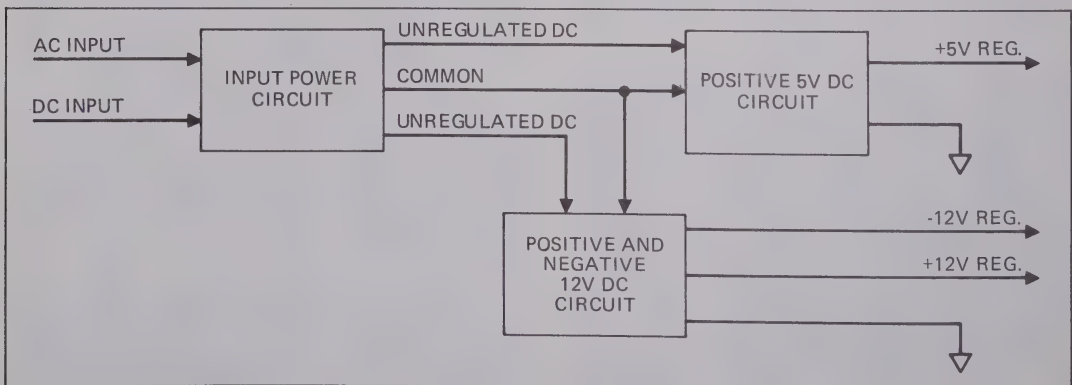


Figure 3-6. Power Supply Functional Sections



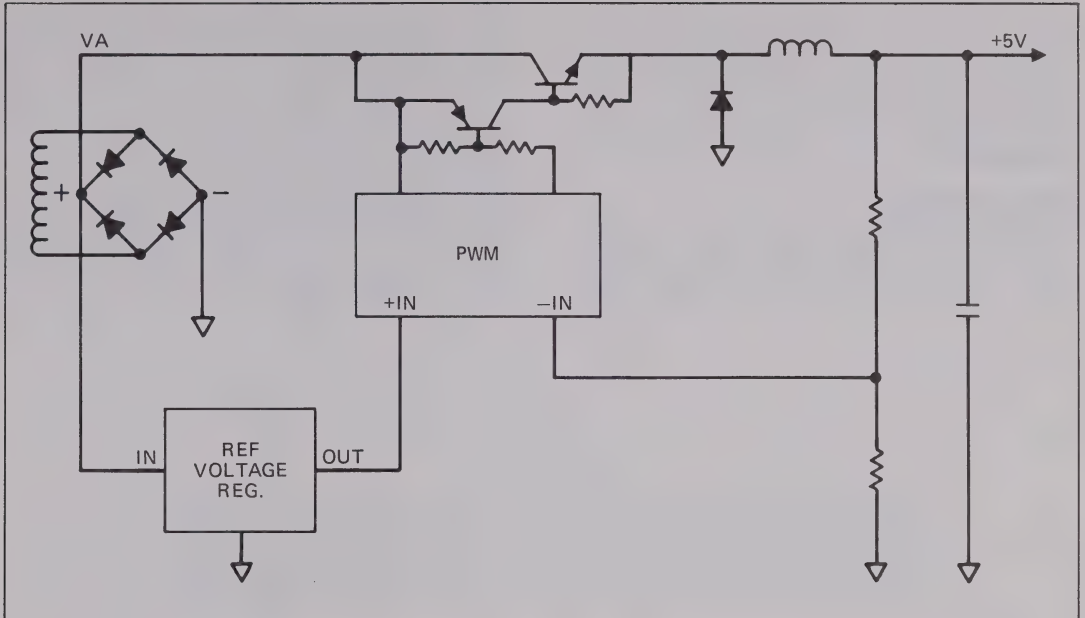


Figure 3-7. Positive 5V dc Simplified Schematic

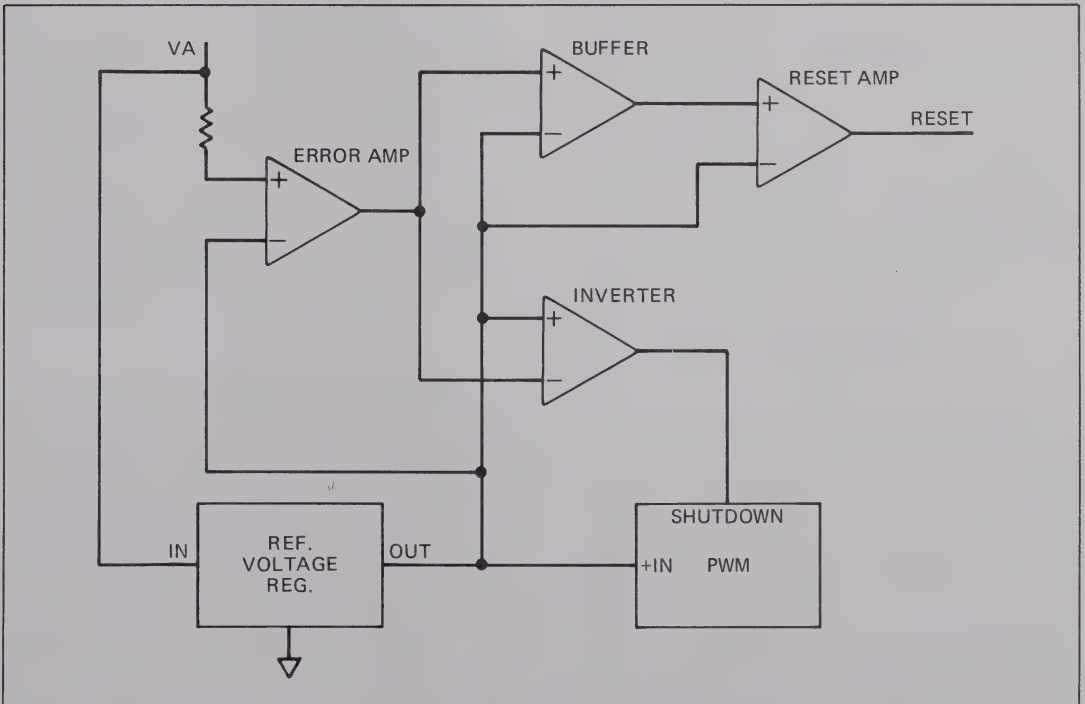


Figure 3-8. Reset and Shutdown Simplified Schematic

3-35. Positive and negative 12V dc power supply circuitry consists of one transformer secondary winding, a bridge rectifier, and two IC voltage regulators. Line voltage is coupled across the transformer, rectified, then regulated by the two regulators. Positive and negative 12V dc outputs are used for control circuitry in some interface options.

### **3-36. Summary**

3-37. The Model 2300A Scanner Mainframe circuitry consists of the power supply circuits, the scanner control circuitry, and the keyboard and display circuitry. Power

supply outputs (+5V, +12V, and -12V) supply all scanner system power. The scanner control circuits communicate with the interface option, the Display/Keyboard, the scanner option cards, and the scanner extenders. The Scanner Control PCB also coordinates and controls all scanner system functions. The Display/Keyboard circuits accept operator programming inputs for relay to the Scanner Control PCB, and display information received from the Scanner Control PCB. Detailed information pertaining to the interface options and scanner option PCBs is presented in Section 6 of this manual.

## Section 4

# Maintenance

### WARNING

**THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRICAL SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN THE OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.**

#### 4-1. INTRODUCTION

4-2. This section of the manual contains maintenance information for the Model 2300A Scanner Mainframe. This includes service information, general maintenance, performance test, calibration adjustments, and troubleshooting. The performance test is recommended as an acceptance test when the instrument is first received, and later as a calibration procedure to verify instrument accuracy at the scheduled calibration periods. Table 4-1, lists the recommended test equipment required to execute both the performance test and the calibration adjustment procedures. If the specified equipment is not available, alternate equipment with equivalent specifications may be substituted.

Table 4-1. Recommended Test Equipment

| EQUIPMENT TYPE     | RECOMMENDED MODEL        |
|--------------------|--------------------------|
| Interface Option   | 2300A—005                |
| Scanner Option PCB | 2300A—002, —003          |
| Input Device       | RTD or Thermocouple      |
| Cable Accessories  | Y7203, Y7204             |
| Test Instrument    | Fluke Model 2180A, 2190A |
| DMM                | Fluke Model 8000A        |
| Oscilloscope       | Tektronics 7603          |

#### 4-3. SERVICE INFORMATION

4-4. The Model 2300A Scanner Mainframe is warranted for a period of 1 year upon delivery to the original purchaser. The WARRANTY is given on the back of the title page located in the front of this manual.

4-5. Factory authorized calibration and service for each Fluke product is available at various worldwide locations. A complete list of these service centers is included in Section 7 of this manual. Shipping information is given in Section 2. If requested, an estimate will be provided to the customer before any work is begun on instruments beyond the warranty period.

#### 4-6. GENERAL MAINTENANCE

#### 4-7. Instrument Disassembly

4-8. To perform certain maintenance procedures, the Model 2300A Scanner Mainframe must be removed from the case and disassembled. The instrument disassembly procedure details the necessary steps to completely disassemble the Scanner Mainframe. The instrument disassembly procedure may be logically reversed to reassemble the Unit. Use the following procedure to disassemble and reassemble the Scanner Mainframe:

1. Disconnect all power and cable assemblies.
2. Remove the four screws in the bottom of the case.

3. Lift the case cover to remove it.
4. Pull the black release buttons on the scanner option card rear panels to release them.
5. Pull the scanner option cards out the rear of the 2300A.
6. Remove the four screws that attach the scanner option card slides to the nylon standoffs on the Scanner Control PCB, and the two screws that attach the slides to the Display/Keyboard PCB.
7. Remove the scanner option card slide assemblies.
8. Remove the four interface option board attaching screws located at the corners of the interface option pcb and the two attaching screws that secure the connector to the rear panel.
9. Disconnect the ribbon cable between the interface option board and the Scanner Control PCB.
10. Remove the interface option PCB.
11. Remove the single screw at the center of the Scanner Control PCB.
12. Disconnect the Display/Keyboard ribbon cable from the Scanner Control PCB.
13. Lift the Display/Keyboard and the Scanner Control PCB out of the case bottom at the same time, then slide the Display/Keyboard forward over the POWER switch to separate it from the Scanner Control PCB.
14. To reassemble the Scanner Mainframe, logically reverse this procedure.

## 4-9. Fuse Replacement

### WARNING

**DISCONNECT ALL POWER INPUTS BEFORE REPLACING FUSES.**

4-10. The ac and dc inputs are individually fuse protected. Both fuses are readily accessible from the outside of the rear panel. To replace a fuse, insert a screwdriver in the grey fuse cap, push the cap in slightly, and turn it ¼ turn counterclockwise. Remove the fuse cap, replace the fuse, and reinstall the fuse cap. The ac line input fuse (F1) requires a 1/8 amp, MDL, slow-blow replacement for 100V to 130V ac operation; fuse F1 requires a 1/16 amp, MDL, slow-blow replacement for

200V to 260V ac operation. The external dc input fuse (F2) requires a 3/4 amp, MDL, slow-blow replacement.

## 4-11. Line Voltage Selection

4-12. Two ac line voltage input ranges are switch selectable in the Model 2300A Scanner Mainframe: 100V to 130V ac, and 200V to 260V ac. The line voltage select switch (S2) position determines the acceptable ac line voltage. To check or change the line voltage select switch position, remove the case cover. (Refer to Instrument Disassembly). Switch S2 is located at the left-rear corner of the Scanner Control PCB, immediately adjacent to the line voltage input connector. If the switch is set for 100V to 130V operation, the colored dot will be positioned next to 100V to 130V marked on the pcb; if the switch is set for 200V to 260V operation, the colored dot will be positioned next to 200V to 260V marked on the pcb.

## 4-13. Cleaning

4-14. Clean the instrument periodically to remove dust, grease, and other contamination. Use the following procedure:

### CAUTION

**Do not use aromatic hydrocarbons or chlorinated solvents for cleaning. They may damage plastic materials used in the instrument.**

1. Clean the front panel and case with a soft cloth dampened with a mild solution of detergent and water.
2. Clean pcb surfaces using clean, dry air at low pressure ( $\leq 20$  psi).
3. If grease is encountered, spray with anhydrous alcohol and remove grime with clean, dry air at low pressure.

## 4-15. PERFORMANCE TEST

4-16. The Model 2300A Scanner Mainframe may be tested for proper performance under actual conditions. At least one scanner option card and one interface option card must be installed in the 2300A Scanner Mainframe for test purposes. An input device appropriate for the scanner option card in use is also required for the performance test. Refer to the proper installation and operating procedures in Section 2 of this manual, and to the option card installation and operating procedures in the appropriate part of Section 6.

4-17. After installing the selected interface option and scanner card option, and after verifying that all



installation instructions have been performed, the following procedure may be used to performance test the Model 2300A Scanner Mainframe:

1. Connect the 2300A to line power and press the power-on switch.
2. Upon initialization, the 2300A Scanner Mainframe front panel LEDs should display the channel number of the highest numeric channel connected.
3. Press the MANUAL switch. The MANUAL switch should light to indicate that the scanner is in manual operating mode.
4. Press the UP and then the DN switch. The channel number displayed should increment and decrement as applicable.
5. Press the CHANNEL DELAY SELECT switch. The CHANNEL DISPLAY LEDs should display the channel delay time, and the decimal point should light to indicate that the display is in seconds.
6. Press the UP switch to increase the delay time, then the DN switch to decrease the delay time. The displayed time should increase, then decrease.
7. Press the MANUAL switch to return the 2300A Scanner Mainframe to manual operation.
8. Set the Channel delay time to 9.9 seconds.
9. Press the UP or DN switch, then press it again immediately. (The CHANNEL DISPLAY should increment or decrement once the first time the switch is pressed, then delay a maximum of the programmed delay time, then increment or decrement rapidly through the channels.)

10. While in manual operation, press the SKIP SELECT switch to program several channels to be skipped.

11. Press the AUTO switch. (The Scanner Mainframe should automatically increment through all connected channels, skipping those programmed to be skipped.)

12. Return the 2300A to manual operation, then un-skip the channels previously selected to be skipped by pressing the SKIP SELECT switch again.

13. Press the AUTO switch. The Scanner mainframe will increment through connected channels without skipping.

**NOTE**

*If the 2300A Scanner Mainframe does not perform as specified, consult the Troubleshooting procedure.*

**4-18. CALIBRATION ADJUSTMENT**

4-19. The basic 2300A Scanner Mainframe does not require calibration adjustment. However, certain interface option cards and some scanner option cards do require periodic calibration adjustment. Refer to the appropriate option information in Section 6 of this manual.

**4-20. TROUBLESHOOTING**

4-21. Troubleshooting information presented in Table 4-2 is intended as a guide to assist in isolating a malfunction to the component level. The table is arranged in a tabular flow-chart format. When a step on the table is complete, check for a decision transfer. If no decision is required, perform the next step on the table in sequence. Test points and component locations referred to in this procedure are shown in Figure 4-1.

**Table 4-2. Troubleshooting Procedure**

| STEP NO. | ACTION                                                                                                       | Go to the step number given for correct response |    |
|----------|--------------------------------------------------------------------------------------------------------------|--------------------------------------------------|----|
|          |                                                                                                              | YES                                              | NO |
| 1.       | Verify Scanner Mainframe installation by performing the installation procedures in Section 2 of this manual. |                                                  |    |
| 2.       | Check the input power fuses.                                                                                 |                                                  |    |
| 3.       | Push the POWER ON switch.                                                                                    |                                                  |    |
| 4.       | Is positive 5V dc present at the power supply test point TP2?                                                | 10                                               | 5  |

Table 4-2. Troubleshooting Procedure (cont)

| STEP NO. | ACTION                                                                                                             | Go to the step number given for correct response |    |
|----------|--------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|----|
|          |                                                                                                                    | YES                                              | NO |
| 5.       | Is dc voltage present at the output of the bridge rectifier (CR2)?                                                 | 7                                                | 6  |
| 6.       | Check the bridge rectifier, transformer, and power switch.                                                         |                                                  |    |
| 7.       | Are pulses present at the transistor switch circuit, from the PWM?                                                 | 8                                                | 9  |
| 8.       | Check the transistor switch circuit.                                                                               |                                                  |    |
| 9.       | Check the PWM and associated circuitry.                                                                            |                                                  |    |
| 10.      | Are all channels scanned in sequence?                                                                              | 12                                               | 11 |
| 11.      | Check the microcomputer.                                                                                           |                                                  |    |
| 12.      | Is data transferred to and from the interface option card?                                                         | 14                                               | 13 |
| 13.      | Check the microcomputer and buffers.                                                                               |                                                  |    |
| 14.      | Do all display LEDs function properly?                                                                             | 18                                               | 15 |
| 15.      | Are the proper Segment Enable signals present at the output of the microcomputer?                                  | 17                                               | 16 |
| 16.      | Check or replace the microcomputer.                                                                                |                                                  |    |
| 17.      | Check the Segment Enable transistors.                                                                              |                                                  |    |
| 18.      | Do the front panel programming controls function properly?                                                         | 20                                               | 19 |
| 19.      | Check the front panel switches and switch buffers.                                                                 |                                                  |    |
| 20.      | Refer to the applicable interface option or scanner option troubleshooting procedures in Section 6 of this manual. |                                                  |    |

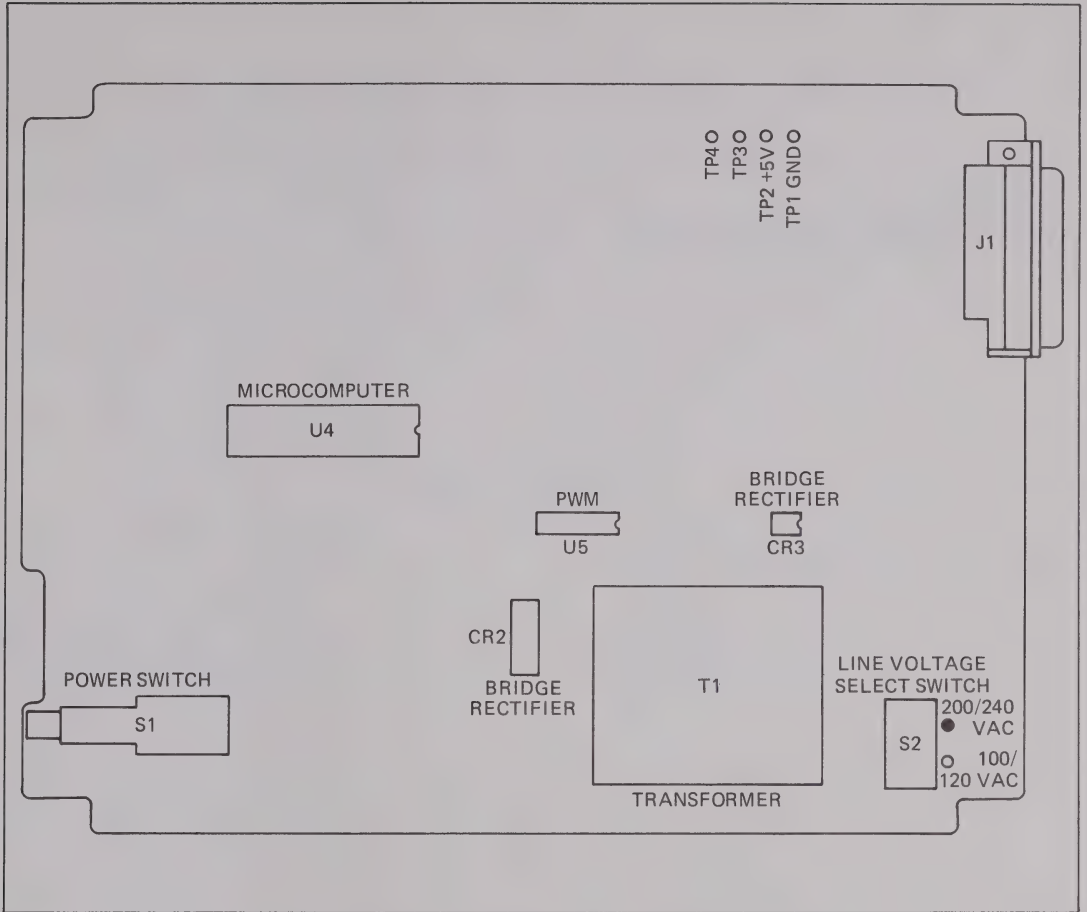


Figure 4-1. Component Location Diagram





# Section 5

## List of Replaceable Parts

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| ASSEMBLY NAME                                 | DRAWING<br>NO. | TABLE |      | FIGURE |      |
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| A2 Display/ Keyboard PCB Assembly .....       | 2300A-4002     | 5-4   | 5-10 | 5-4    | 5-11 |

## 5-1. INTRODUCTION

5-2. This section contains an illustrated parts breakdown of the instrument. A similar parts listing for each of the options will be found in Section 6. Components are listed alphanumerically by assembly. Both electrical and mechanical components are listed by reference designation. Each listed part is shown in an accompanying illustration.

5-3. Parts lists include the following information:

1. Reference Designation.
2. Description of each part.
3. FLUKE Stock Number.
4. Federal Supply Code for Manufacturers. (See Section 7 for Code-to-Name list.)
5. Manufacturer's Part Number.
6. Total Quantity of components per assembly.
7. Recommended Quantity: This entry indicates the recommended number of spare parts necessary to support one to five instruments for a period of 2 years. This list presumes an availability of common electronic parts at the maintenance site. For maintenance for 1 year or more at an isolated site, it is recommended that at least one of each assembly in the instrument be stocked (see paragraph 5-7). In the case of optional subassemblies, plug-ins, etc., that are not always part of the instrument, or are deviations from the basic instrument model, the REC QTY column lists the recommended spares quantity for the items in that particular assembly.

## 5-4. HOW TO OBTAIN PARTS

5-5. Components may be ordered directly from the manufacturer by using the manufacturer's part number, or from the John Fluke Mfg. Co., Inc. or its authorized representative by using the FLUKE STOCK NUMBER. In the event the part you order has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions, if necessary.

5-6. To ensure prompt and efficient handling of your order, include the following information.

1. Quantity.
2. FLUKE Stock Number.
3. Description.
4. Reference Designation.
5. Printed Circuit Board Part Number and Revision Letter.
6. Instrument Model and Serial Number.

5-7. A Recommended Spare Parts Kit for your basic instrument is available from the factory. This kit contains those items listed in the REC QTY column of the parts list in the quantities recommended.

5-8. Parts price information is available from the John Fluke Mfg. Co., Inc. or its representative. Prices are also available in a Fluke Replacement Parts Catalog, which is available on request.

### CAUTION



**Indicated devices are subject to damage by static discharge.**

Table 5-1. Final Assembly, 2300A Scanner Mainframe

| REF<br>DES                    | DESCRIPTION                                                     | FLUKE<br>STOCK<br>NO. | MFG<br>SPLY<br>CODE | MFG PART NO.<br>OR TYPE | TOT<br>QTY | REC<br>QTY | N<br>O<br>T<br>E |
|-------------------------------|-----------------------------------------------------------------|-----------------------|---------------------|-------------------------|------------|------------|------------------|
|                               | ⊗ FINAL ASSEMBLY<br>FIGURE 5-1 (2300A-T&B)                      | 2300A                 |                     | SCANNER MAINFRAME       |            |            |                  |
|                               | ⊗ CHASSIS ASSEMBLY                                              |                       |                     |                         | 1          |            | A                |
| A1                            | ⊗ SCANNER CONTROL PCB ASSEMBLY                                  | 497636                | 89536               | 497636                  | 1          |            |                  |
| A2                            | ⊗ DISPLAY/KEYBOARD PCB ASSEMBLY                                 | 497750                | 89536               | 497750                  | 1          |            |                  |
| F1                            | FUSE                                                            | ORDER                 | FOR                 | APPROPRIATE VOLTAGE     | 1          |            |                  |
|                               | FUSE, SLOW-BLOW, 1/16 AMP (200/240V)                            | 163030                | 71400               | MDL1-16A                |            |            |                  |
|                               | FUSE, SLOW-BLOW, 1/8 AMP (100/120V)                             | 166488                | 71400               | MDL1-8A                 |            |            |                  |
| F2                            | FUSE, SLOW-BLOW, 3/4 AMP                                        | 109256                | 71400               | MDL3-4A                 | 1          |            |                  |
| H1                            | SCREW, PHP, 4-40 X 1/4                                          | 129890                | 73734               | 19022                   | 2          |            |                  |
| H2                            | SCREW, FHP, 6-32 X 3/8                                          | 114363                | 89536               | 114363                  | 2          |            |                  |
| H3                            | SCREW, FHP, 6-32 X 5/8                                          | 114876                | 89536               | 114876                  | 4          |            |                  |
| H4                            | SCREW, FHP, 6-32 X 1                                            | 203471                | 89536               | 203471                  | 2          |            |                  |
| MP1                           | BRACKET, SIDE                                                   | 515312                | 89536               | 515312                  | 1          |            |                  |
| MP2                           | CARD GUIDE                                                      | 229047                | 89536               | 229047                  | 4          |            |                  |
| MP3                           | GROMMET                                                         | 519827                | 89536               | 519827                  | 1          |            |                  |
| MP4                           | NAMEPLATE, SERIAL NUMBER                                        | 472795                | 89536               | 472795                  | 1          |            |                  |
| MP5                           | PANEL, BLANK (REAR)                                             | 531202                | 89536               | 531202                  | 1          |            |                  |
| MP6                           | PLUNGER                                                         | 519835                | 89536               | 519835                  | 1          |            |                  |
| MP7                           | DECAL, REF DES                                                  | 535252                | 89536               | 535252                  | 1          |            |                  |
| TM1                           | INSTRUCTION MANUAL (2300A) (NOT SHOWN)                          | 522078                | 89536               | 522078                  | 1          |            |                  |
| W1                            | LINE CORD (NOT SHOWN)                                           | 343723                | 89536               | 343723                  | 1          |            |                  |
| RECOMMENDED SPARE PARTS KITS: |                                                                 |                       |                     |                         |            |            |                  |
| KIT 1                         | BASIC 2300A UNIT P/N 539882.                                    |                       |                     |                         |            |            |                  |
| KIT 2                         | BASIC 2300A AND 002 OTION.<br>ORDER P/N 539882 AND P/N 539890.  |                       |                     |                         |            |            |                  |
| KIT 3                         | BASIC 2300A AND 003 OPTION.<br>ORDER P/N 539882 AND P/N 539908. |                       |                     |                         |            |            |                  |
| KIT 4                         | BASIC 2300A AND 005 OPTION.<br>ORDER P/N 539882 AND 539916.     |                       |                     |                         |            |            |                  |
| A                             | ORDER ONLY REPLACEABLE PARTS AS<br>LISTED FOR THIS ASSEMBLY.    |                       |                     |                         |            |            |                  |

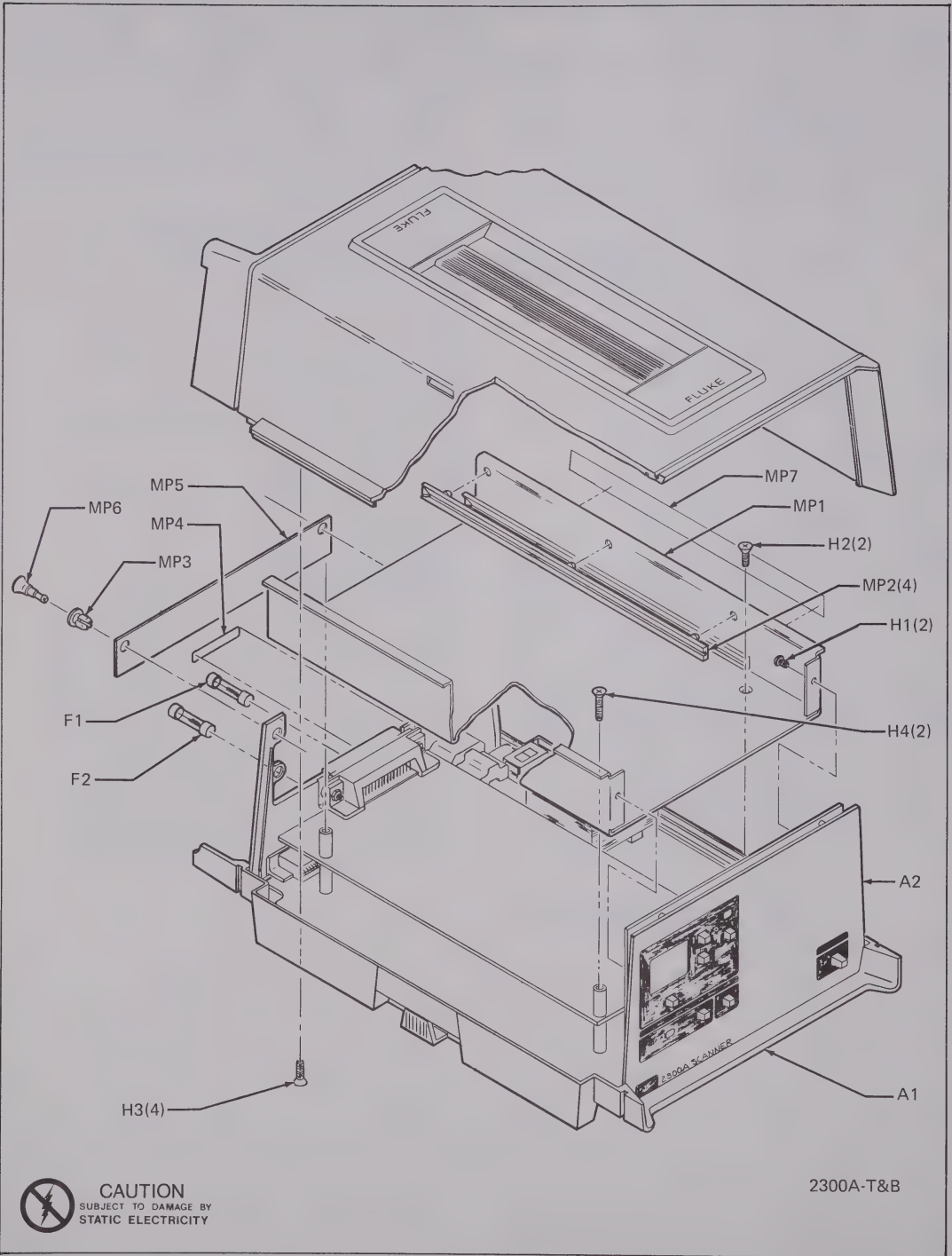


Figure 5-1. Final Assembly, 2300A Scanner Mainframe



Table 5-2. 2300A Chassis Assembly

| REF<br>DES | DESCRIPTION                                   | FLUKE<br>STOCK<br>NO. | MFG<br>SPLY<br>CODE | MFG PART NO.<br>OR TYPE | TOT<br>QTY | REC<br>QTY | N<br>O<br>T<br>E |
|------------|-----------------------------------------------|-----------------------|---------------------|-------------------------|------------|------------|------------------|
|            | ② CHASSIS ASSEMBLY<br>FIGURE 5-2 (2300A-4201) |                       |                     |                         |            |            | REF              |
| A1         | ② SCANNER CONTROL PCB ASSEMBLY                | 497636                | 89536               | 497636                  |            |            | REF              |
| A2         | ② DISPLAY/KEYBOARD PCB ASSEMBLY               | 497750                | 89536               | 497750                  |            |            | REF              |
| H1         | SCREW, PHP, 4-40 X 5/16                       | 152116                | 89536               | 152116                  |            |            | 6                |
| H2         | SCREW, PHP, THD/FORM, 3/8                     | 156489                | 89536               | 156489                  |            |            | 1                |
| MP1        | BAIL, STAND                                   | 467555                | 89536               | 467555                  |            |            | 1                |
| MP2        | BASE, STANDARD                                | 454702                | 89536               | 454702                  |            |            | 1                |
| MP3        | CONNECTOR ASSEMBLY                            | 448092                | 31746               | D-20418-2               |            |            | 2                |
| MP4        | COVER, W/SHIELD, "D" SIZE                     | 516690                | 89536               | 516690                  |            |            | 1                |
| MP5        | DECAL, BASE SIDES                             | 473652                | 89536               | 473652                  |            |            | 2                |
| MP6        | DECAL, BOTTOM                                 | 495531                | 89536               | 495531                  |            |            | 1                |
| MP7        | DECAL, FRONT PANEL                            | 495523                | 89536               | 495523                  |            |            | 1                |
| MP8        | DECAL, REAR PANEL                             | 495549                | 89536               | 495549                  |            |            | 1                |
| MP9        | FOOT, NONSKID                                 | 467571                | 89536               | 467571                  |            |            | 4                |
| MP10       | GROMMET                                       | 104273                | 89536               | 104273                  |            |            | 1                |
| MP11       | HOLDER, COMPONENT                             | 422865                | 89536               | 422865                  |            |            | 1                |
| MP12       | LATCH                                         | 467548                | 89536               | 467548                  |            |            | 2                |
| MP13       | PANEL, FRONT                                  | 497461                | 89536               | 497461                  |            |            | 1                |
| MP14       | PANEL, REAR                                   | 497453                | 89536               | 497453                  |            |            | 1                |
| MP15       | SHIELD, PTI BASE                              | 473892                | 89536               | 473892                  |            |            | 1                |
| W2         | CABLE ASSEMBLY                                | 475228                | 89536               | 475228                  |            |            | 1                |
| XF1        | FUSEHOLDER (ORDER AS SEPARATE PIECES)         |                       |                     |                         |            |            |                  |
|            | CAP (XF1)                                     | 460238                | 89536               | 460238                  |            |            | 2                |
|            | BODY (XF1)                                    | 375188                | 89536               | 375188                  |            |            | 2                |
| XF2        | FUSEHOLDER                                    |                       |                     |                         |            |            |                  |
|            | CAP (XF2)                                     | 460238                | 89536               | 460238                  |            |            | REF              |
|            | BODY (XF2)                                    | 375188                | 89536               | 375188                  |            |            | REF              |

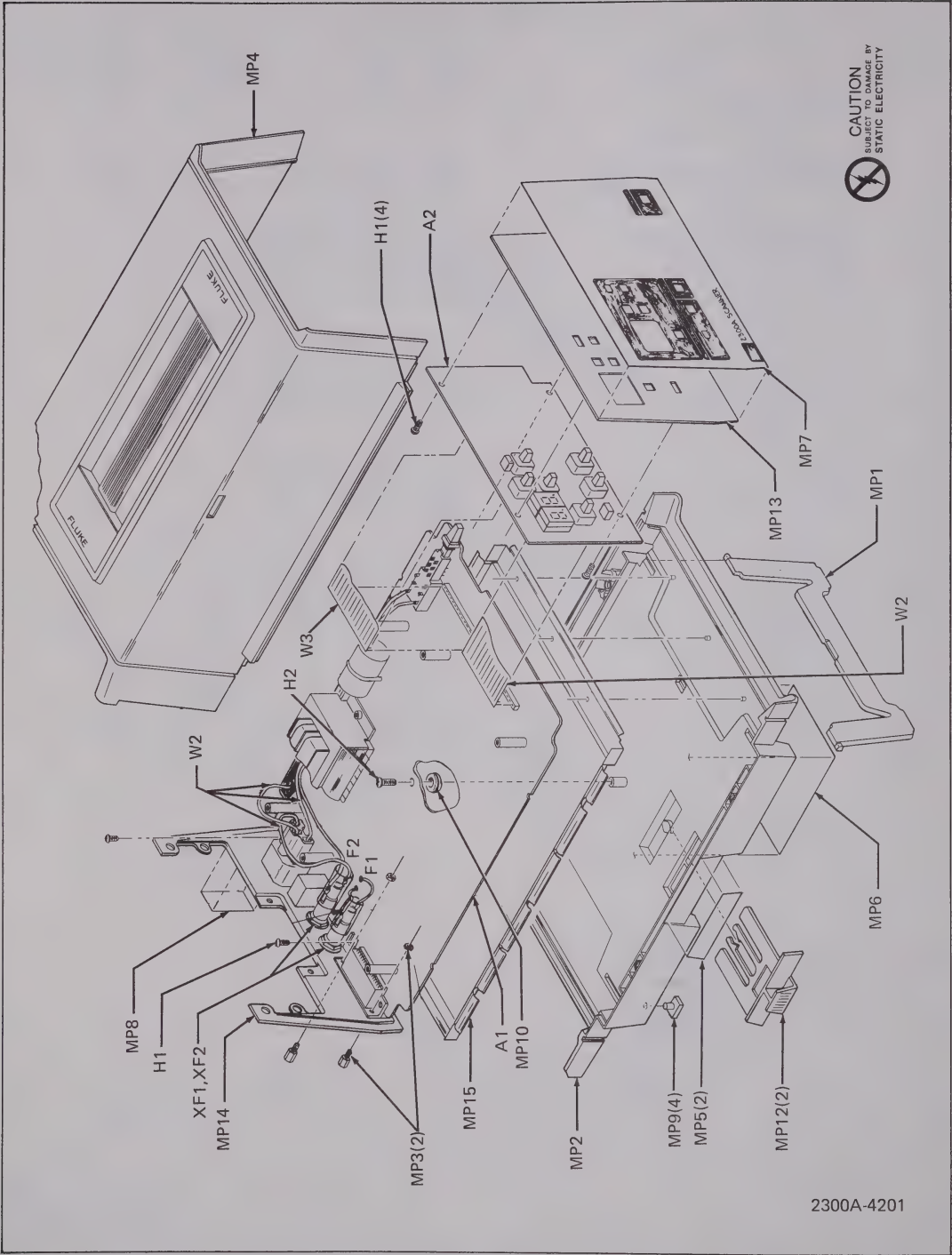


Figure 5-2. 2300A Chassis Assembly

Table 5-3. A1, Scanner Control PCB Assembly

| REF<br>DES | DESCRIPTION                                                | FLUKE<br>STOCK<br>NO. | MFG<br>SPLY<br>CODE | MFG PART NO.<br>OR TYPE | TOT<br>QTY | REC<br>QTY | NO<br>TE |
|------------|------------------------------------------------------------|-----------------------|---------------------|-------------------------|------------|------------|----------|
| A1         | ⊙ SCANNER CONTROL PCB ASSEMBLY<br>FIGURE 5-3 (2300A-4001T) | 497636                | 89536               | 497636                  | REF        |            |          |
| C1         | CAP, CER, 0.22 UF +/-20%, 50V                              | 309849                | 71590               | CW30C224K               | 6          |            |          |
| C2         | CAP, ELECT, 4000 UF -10/+100%, 25V                         | 370734                | 80031               | 3044TS043U025           | 1          |            |          |
| C3         | CAP, CER, 0.01 UF +/-20%, 100V                             | 407361                | 72982               | 8121-A100-W5R-103M      | 1          |            |          |
| C4         | CAP, CER, 0.22 UF +/-20%, 50V                              | 309849                | 71590               | CW30C224K               | REF        |            |          |
| C5         | CAP, ELECT, 470 UF -10/+100%, 10V/13V                      | 519488                | 56289               | 672D477H012DM5C         | 1          |            |          |
| C6         | CAP, CER, 0.22 UF +/-20%, 50V                              | 309849                | 71590               | CW30C224K               | REF        |            |          |
| C7         | CAP, CER, .047 UF +/-20%, 50V                              | 460733                | 71590               | CW20C473M               | 3          |            |          |
| C8         | CAP, CER, 0.22 UF +/-20%, 50V                              | 309849                | 71590               | CW30C224K               | REF        |            |          |
| C9         | CAP, CER, .047 UF +/-20%, 50V                              | 460733                | 71590               | CW20C473M               | REF        |            |          |
| C10        | CAP, MICA, 3300 PF +/-5%, 500V                             | 148320                | 72136               | DM19F332J               | 1          |            |          |
| C11        | CAP, CER, .047 UF +/-20%, 50V                              | 460733                | 71590               | CW20C473M               | REF        |            |          |
| C12        | CAP, TA, 22 UF +/-20%, 35V                                 | 394775                | 56289               | 196D226X0035TE4         | 2          |            |          |
| C13        | CAP, TA, 22 UF +/-20%, 35V                                 | 394775                | 56289               | 196D226X0035TE4         | REF        |            |          |
| C14        | CAP, TA, 10 UF +/-20%, 20V                                 | 330662                | 56289               | 196D106X0020KA1         | 2          |            |          |
| C15        | CAP, TA, 10 UF +/-20%, 20V                                 | 330662                | 56289               | 196D106X0020KA1         | REF        |            |          |
| C16        | CAP, CER, 0.22 UF +/-20%, 50V                              | 309849                | 71590               | CW30C224K               | REF        |            |          |
| C17        | CAP, CER, 0.22 UF +/-20%, 50V                              | 309849                | 71590               | CW30C224K               | REF        |            |          |
| CR1        | DIODE, SI, RECTIFIER                                       | 116111                | 05277               | 1N4817                  | 1          | 1          |          |
| CR2        | RECTIFIER BRIDGE, 2 AMP                                    | 392910                | 09423               | FB200                   | 1          | 1          |          |
| CR3        | RECTIFIER BRIDGE, 1 AMP                                    | 504274                | 83003               | VM18                    | 1          | 1          |          |
| CR4        | RECTIFIER, SI                                              | 483701                | 14099               | 5FF10                   | 1          | 1          |          |
| CR5        | DIODE, SI, HI-SPEED SWITCHING                              | 203323                | 07910               | 1N4448                  | 1          | 1          |          |
| CR6        | DIODE, ZENER, +/-2%, 5.6V                                  | 325787                | 15818               | TD333406                | 1          | 1          |          |
| H1         | SCREW, 6-32 X .312                                         | 152157                | 89536               | 152157                  | 2          |            |          |
| H2         | SCREW, PHP, THRD/FORM, 3/8 (NOT SHOWN)                     | 501114                | 89536               | 501114                  | 2          |            |          |
| J1         | CONNECTOR, 25-PIN                                          | 461996                | 00779               | 206584-1                | 1          |            |          |
| J2         | SOCKET, 22-PIN                                             | 443069                | 00779               | 1-583773-0              | 2          |            |          |
| J3         | SOCKET, 22-PIN                                             | 443069                | 00779               | 1-583773-0              | REF        |            |          |
| J4         | CONNECTOR, 18-PIN                                          | 435024                | 00779               | 583773-8                | 1          |            |          |
| L1         | CHOKE                                                      | 490870                | 89536               | 490870                  | 1          |            |          |
| MP1        | BUTTON, SWITCH, GREEN (TO S1)                              | 445197                | 89536               | 445197                  | 1          |            |          |
| MP2        | HOLDER, COMPONENT (TO Y1)                                  | 422865                | 98159               | 2829-75-2               | 1          |            |          |
| MP3        | BRACKET, XFMR                                              | 531210                | 89536               | 531210                  | 1          |            |          |
| Q1         | XSTR, S1, PNP                                              | 195974                | 04713               | 2N3906                  | 1          | 1          |          |
| Q2         | XSTR, S1, NPN                                              | 325761                | 09214               | D44C5                   | 1          | 1          |          |
| R1         | RES, MTL. FILM, 133K +/-1%, 1/8W                           | 289074                | 91637               | CMF551333F              | 1          |            |          |
| R2         | RES, MTL. FILM, 40.2K +/-1%, 1/8W                          | 235333                | 91637               | CMF554022F              | 1          |            |          |
| R3         | RES, DEP. CAR, 1M +/-5%, 1/4W                              | 348987                | 80031               | CR251-4-5P1M            | 5          |            |          |
| R4         | RES, DEP. CAR, 1M +/-5%, 1/4W                              | 348987                | 80031               | CR251-4-5P1M            | REF        |            |          |
| R5         | RES, DEP. CAR, 1M +/-5%, 1/4W                              | 348987                | 80031               | CR251-4-5P1M            | REF        |            |          |
| R6         | RES, DEP. CAR, 160K +/-5%, 1/4W                            | 442442                | 80031               | CR251-4-5P160K          | 1          |            |          |
| R7         | RES, DEP. CAR, 20K +/-5%, 1/4W                             | 441477                | 80031               | CR251-4-5P20K           | 2          |            |          |
| R8         | RES, DEP. CAR, 20K +/-5%, 1/4W                             | 441477                | 80031               | CR251-4-5P20K           | REF        |            |          |
| R9         | RES, DEP. CAR, 240 +/-5%, 1/4W                             | 376624                | 80031               | CR251-4-5P240F          | 1          |            |          |
| R10        | RES, DEP. CAR, 910 +/-5%, 1/4W                             | 442335                | 80031               | CR251-4-5P910F          | 1          |            |          |
| R11        | RES, DEP. CAR, 68 +/-5%, 1/4W                              | 414532                | 80031               | CR251-4-5P68E           | 1          |            |          |
| R12        | RES, COMP, 51 +/-5%, 1/2W                                  | 144717                | 01121               | EB5105                  | 1          |            |          |

Table 5-3. A1, Scanner Control PCB Assembly (cont)

| REF<br>DES | DESCRIPTION                                                                                                                               | FLUKE<br>STOCK<br>NO. | MFG<br>SPLY<br>CODE | MFG PART NO.<br>OR TYPE | TOT<br>QTY | REC<br>QTY | N<br>O<br>T<br>E |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------------|-------------------------|------------|------------|------------------|
| R15        | RES, WW, 0.15 +/-5%, 2W                                                                                                                   | 325712                | 89536               | 325712                  | 1          |            |                  |
| R16        | RES, MTL. FILM, 7.15K +/-1%, 1/8W                                                                                                         | 260356                | 91637               | CMF557151F              | 1          |            |                  |
| R18        | RES, DEP. CAR, 3.9K +/-5%, 1/4W                                                                                                           | 342600                | 80031               | CR251-4-5P3K9           | 1          |            |                  |
| R19        | RES, DEP. CAR, 1M +/-5%, 1/4W                                                                                                             | 348987                | 80031               | CR251-4-5P1M            | REF        |            |                  |
| R20        | RES, MTL. FILM, 5.23K +/-1%, 1/8W                                                                                                         | 294876                | 91637               | CMF555231F              | 1          |            |                  |
| R21        | RES, MTL. FILM, 4.99K +/-1%, 1/8W                                                                                                         | 168252                | 91637               | CMF554991F              | 1          |            |                  |
| R22        | RES, DEP. CAR, 10K +/-5%, 1/4W                                                                                                            | 348839                | 80031               | CR251-4-5P10K           | 1          |            |                  |
| R23        | RES, DEP. CAR, 510K +/-5%, 1/4W                                                                                                           | 442491                | 80031               | CR251-4-5P510K          | 1          |            |                  |
| R24        | RES, DEP. CAR, 1M +/-5%, 1/4W                                                                                                             | 348987                | 80031               | CR251-4-5P1M            | REF        |            |                  |
| S1         | SWITCH ASSEMBLY                                                                                                                           | 473355                | 89536               | 473355                  | 1          |            |                  |
| S2         | SWITCH                                                                                                                                    | 234278                | 89536               | 234278                  | 1          |            |                  |
| T1         | TRANSFORMER, POWER                                                                                                                        | 515593                | 89536               | 515593                  | 1          |            |                  |
| TB1        | TERMINAL BLOCK                                                                                                                            | 479006                | 89536               | 479006                  | 1          |            |                  |
| TP1-TP7    | CONNECTOR, POST                                                                                                                           | 267500                | 89536               | 267500                  | 7          |            |                  |
| U1         | ⊗ IC, C-MOS, HEX BUFFER/INVERTERS                                                                                                         | 381848                | 04713               | MC14049CP               | 1          | 1          |                  |
| U3         | ⊗ IC, C-MOS, NAND GATES, TRIPLE, 3-INPUT                                                                                                  | 375147                | 02735               | CD4023AE                | 1          | 1          |                  |
| U4         | IC, MICRO-PROCESSOR<br>SEE APPROPRIATE OPTION PARTS LIST<br>IN SECTION 6 FOR THE U4 INSTALLATION<br>ON THE A1 PCB ASSEMBLY. (FOOTNOTES A) |                       |                     |                         |            |            |                  |
| U5         | IC, LIN, REG PULSE WIDTH MODULATOR                                                                                                        | 454678                | 01295               | SG3524N                 | 1          | 1          |                  |
| U6         | IC, LIN, QUAD, COMPARATOR                                                                                                                 | 387233                | 12040               | LM339N                  | 1          | 1          |                  |
| U7         | IC, LIN, 2.5 VOLT BAND-GAP REFERENCE                                                                                                      | 472845                | 04713               | MC1403V                 | 1          | 1          |                  |
| U8         | IC, LIN, POSITIVE VOLTAGE REG                                                                                                             | 408138                | 07263               | A78L12WC                | 1          | 1          |                  |
| U9         | IC, LIN, 3-TERMINAL, NEG FIXED VOLT NEG                                                                                                   | 473819                | 07263               | A79L12AWC               | 1          | 1          |                  |
| XU4        | SOCKET, IC, 40-PIN (TO U4) (NOT SHOWN)                                                                                                    | 418988                | 91506               | 340-AG39D               | 1          |            |                  |
| Y1         | CRYSTAL, QUARTZ, 4.00 MHZ                                                                                                                 | 474072                | 89536               | 474072                  | 1          |            |                  |
| Z1         | RESISTOR NETWORK, 10K, 16-PIN                                                                                                             | 500710                | 89536               | 500710                  | 1          |            |                  |



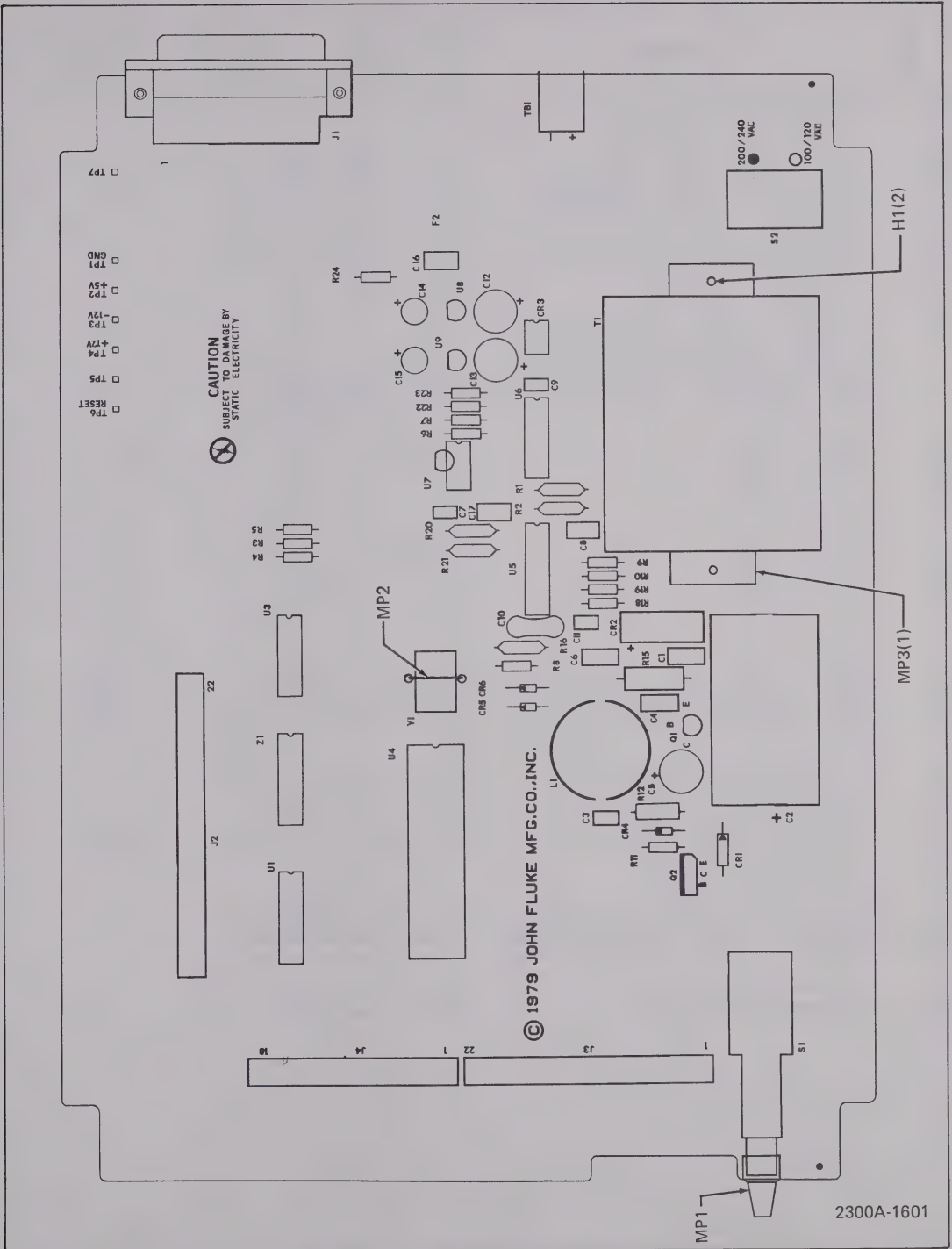


Figure 5-3. A1 Scanner Control PCB Assembly

Table 5-4. A2, Display/Keyboard PCB Assembly

| REF<br>DES | DESCRIPTION                                                 | FLUKE<br>STOCK<br>NO. | MFG<br>SPLY<br>CODE | MFG PART NO.<br>OR TYPE | TOT<br>QTY | REC<br>QTY | N<br>O<br>T<br>E |
|------------|-------------------------------------------------------------|-----------------------|---------------------|-------------------------|------------|------------|------------------|
| A2         | ② DISPLAY/KEYBOARD PCB ASSEMBLY<br>FIGURE 5-4 (2300A-4002T) | 497750                | 89536               | 497750                  | REF        |            |                  |
| CR1        | DIODE, LIGHT EMITTING, RED                                  | 504761                | 29083               | MV57124                 | 2          | 2          |                  |
| DS1        | LED, DISPLAY, 7-SEG (COLOR MATCHED)                         | 418012                | 28480               | 5082-7651               | 2          |            |                  |
| DS2        | LED, DISPLAY, 7-SEG (COLOR MATCHED)                         | 418012                | 28480               | 5082-7651               | REF        |            |                  |
| J9A        | CONNECTOR, EDGE (ON CIRCUIT SIDE)                           | 516955                | 01295               | H421121-18              | 2          |            |                  |
| J9B        | CONNECTOR, EDGE (ON CIRCUIT SIDE)                           | 516955                | 01295               | H421121-18              | REF        |            |                  |
| MP1        | PUSHBUTTON, BLACK (TO S3, S4)                               | 419937                | 89536               | 419937                  | 2          |            |                  |
| MP2        | PUSHBUTTON, YELLOW (TO S1)                                  | 419937                | 89536               | 419937                  | 1          |            |                  |
| MP3        | SPACER, LED (TO CR1, CR2) (NOT SHOWN)                       | 434399                | 89536               | 434399                  | 2          |            |                  |
| P3         | SOCKET, 22 CONTACT (ON CIRCUIT SIDE)                        | 443069                | 00779               | 1-583773-0              | 1          |            |                  |
| P4         | SOCKET, 18 CONTACT (ON CIRCUIT SIDE)                        | 435024                | 00779               | 583773-8                | 1          |            |                  |
| Q1         | XSTR, SI, PNP                                               | 195974                | 04713               | 2N3906                  | 11         | 3          |                  |
| Q2         | XSTR, SI, NPN                                               | 218396                | 04713               | 2N3904                  | 3          |            |                  |
| Q3         | XSTR, SI, PNP                                               | 195974                | 04713               | 2N3906                  | REF        |            |                  |
| Q4         | XSTR, SI, NPN                                               | 218396                | 04713               | 2N3904                  | REF        |            |                  |
| Q5         | XSTR, SI, NPN                                               | 218396                | 04713               | 2N3904                  | REF        |            |                  |
| Q6         | XSTR, SI, PNP                                               | 195974                | 04713               | 2N3906                  | REF        |            |                  |
| Q7         | XSTR, SI, PNP                                               | 195974                | 04713               | 2N3906                  | REF        |            |                  |
| Q8         | XSTR, SI, PNP                                               | 195974                | 04713               | 2N3906                  | REF        |            |                  |
| Q9         | XSTR, SI, PNP                                               | 195974                | 04713               | 2N3906                  | REF        |            |                  |
| Q10        | XSTR, SI, PNP                                               | 195974                | 04713               | 2N3906                  | REF        |            |                  |
| Q11        | XSTR, SI, PNP                                               | 195974                | 04713               | 2N3906                  | REF        |            |                  |
| Q12        | XSTR, SI, PNP                                               | 195974                | 04713               | 2N3906                  | REF        |            |                  |
| Q13        | XSTR, SI, PNP                                               | 195974                | 04713               | 2N3906                  | REF        |            |                  |
| Q14        | XSTR, SI, PNP                                               | 195974                | 04713               | 2N3906                  | REF        |            |                  |
| R1         | RES, DEP. CAR, 1K +/-5%, 1/4W                               | 343426                | 80031               | CR251-4-5P1K            | 3          |            |                  |
| R2         | RES, DEP. CAR, 1K +/-5%, 1/4W                               | 343426                | 80031               | CR251-4-5P1K            | REF        |            |                  |
| R3         | RES, DEP. CAR, 1K +/-5%, 1/4W                               | 343426                | 80031               | CR251-4-5P1K            | REF        |            |                  |
| R4         | RES, DEP. CAR, 100K +/-5%, 1/4W                             | 348920                | 80031               | CR251-4-5P100K          | 1          |            |                  |
| S1         | SWITCH, NONLIGHTED (YELLOW)                                 | 507319                | 89536               | 507319                  | 3          |            |                  |
| S2         | SWITCH, LIGHTED, MED. YEL.                                  | 528216                | 89536               | 528216                  | 2          |            |                  |
| S3         | SWITCH, NONLIGHTED (BLACK)                                  | 507319                | 89536               | 507319                  | REF        |            |                  |
| S4         | SWITCH, NONLIGHTED (BLACK)                                  | 507319                | 89536               | 507319                  | REF        |            |                  |
| S5         | SWITCH, LIGHTED (GRAY)                                      | 507335                | 89536               | 507335                  | 1          |            |                  |
| S6         | SWITCH, LIGHTED, MED. YEL.                                  | 528216                | 89536               | 528216                  | REF        |            |                  |
| U1         | ② IC, C-MOS, TRI-STATE HEX NON INVRTNG BUF                  | 407759                | 12040               | MM80C97N                | 1          |            |                  |
| XDS1       | SOCKET, IC, 14-PIN (TO DS1) (NOT SHOWN)                     | 370304                | 12040               | MM74C906N               | 2          |            |                  |
| XDS2       | SOCKET, IC, 14-PIN (TO DS2) (NOT SHOWN)                     | 370304                | 12040               | MM74C906N               | REF        |            |                  |
| Z1         | RESISTOR NETWORK, 1K                                        | 358119                | 89536               | 358119                  | 1          |            |                  |
| Z2         | RESISTOR NETWORK, 82 OHMS                                   | 478859                | 89536               | 478859                  | 1          |            |                  |







Section 6

Option & Accessory Information

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## **6-1. INTRODUCTION**

6-2. This section of the manual contains information concerning the options and accessories available for use with the Model 2300A Scanner Mainframe. It consists of an introductory section, an accessory section, and a series of option subsections. All option and accessories are listed by model number or option number in the table of contents. Corresponding subsection page numbers are listed, as is additional documentation location information.

## **6-3. ACCESSORIES**

6-4. The less complex accessories are fully documented in the accessories subsection; complex accessories are briefly described in the accessories subsection and fully documented in individual manuals which are provided with the accessory when purchased.

## **6-5. OPTIONS**

6-6. Each option is documented in individual subsections of this manual section. Each subsection contains all information necessary to install, operate, and maintain the option, including a list of replaceable parts. Unique page and paragraph numbering, which corresponds to the option number, facilitates subsection location. For example, a page numbered 602-5, is the fifth page of information concerning Option -02. A paragraph numbered 602-5 is the fifth paragraph concerning Option -02.

6-7. Subsections for options available at the time of this printing are included in this manual. Additional options will be available in the future. Contact your nearest Fluke sales representative for a current list of available options.

## Accessories

### 600-1. INTRODUCTION

600-2. Four accessories are available for use with the 2300A Scanner Mainframe: a rack mount accessory, two cable accessories, and the Model 2301A Scanner Extender. The rack mount accessory and cable accessories are documented in this section, and the Model 2301A Scanner Extender is described briefly, with further documentation contained in an individual manual supplied with the accessory when purchased.

### 600-3. RACK MOUNT ACCESSORIES

600-4. A rack mount accessory for installing the Model 2300A Scanner mainframe in a standard 19 inch electronics equipment rack is available in either of two configurations: a single instrument rack mount panel (Y2016), or a dual instrument rack mount panel (Y2017). A single Model 2300A Scanner Mainframe may be mounted in an electronics equipment rack using the Y2016 Rack Mount kit; two 2300A Scanner Mainframes, or a 2300A Scanner Mainframe and one additional instrument in the same size PTI case (2301A Scanner Extender uses the same size case), may be rack mounted using the Y2017 Rack Mount. Installation instructions are included with each rack mount accessory.

### 600-5. CABLE ACCESSORIES

600-6. Two cable accessories are available for use with the 2300A Scanner Mainframe. Both cables are 36-pin, PTI compatible cables, and either may be used to connect a PTI printer (2020A, 2021A, or 2030A) to the scanner if interface Option -005 is installed in the scanner. Cable assembly Y7203 is 2 feet long, cable assembly Y7204 is 5 feet long. Both cable assemblies have a 36-pin male connector on one end and a 36-pin female connector on the other end.

### 600-7. MODEL 2301A SCANNER EXTENDER

600-8. The Model 2301A Scanner Extender provides additional scanner channel capability for the Model 2300A Scanner Mainframe. Each scanner extender may contain a maximum of three additional scanner option cards, for a total of 30 additional scanner input connections. Three scanner extenders may be connected to one 2300A Scanner Mainframe, providing a total system scan capability of 100 channels. The system capability is limited to 100 channels by the 2300A Scanner Mainframe control capability, although there are 110 scanner channel input connections available.

600-9. Scanner extenders are packaged in the same size PTI cases as that used by the 2300A Scanner Mainframe, so the extender may either be stacked with the 2300A or rack mounted with the Scanner Mainframe using the Y2017 dual chassis rack mount. Each scanner extender has a connecting cable extending from the rear panel for connection to the scanner mainframe extender connector. When more than one extender is used in conjunction with a scanner mainframe, the scanner extenders may be daisy-chained together by connecting the cable from one extender to the connector on the next, with the cable from the final scanner extender connected to the 2300A extender connector.

600-10. The Model 2301A Scanner Extender meets all environmental specifications given for the Model 2300A Scanner Mainframe. Additional scanner extender specifications are given in Table 600-1. Refer to the Model 2301A Scanner Extender Instruction Manual for additional information.

**Table 600-1. 2301A Scanner Extender Chassis Specifications**

**DIMENSIONS:** 20.45 cm W x 13.08 cm H x 32.69 cm L (8.05 in x 5.15 in x 12.85 in)

**INPUT POWER:** 5V dc; 1 watt (Supplied by 2300A)

**CHANNEL CAPACITY:** 30 channels maximum

**INPUT/OUTPUT CONNECTION:** Cable-mounted, 25-pin connector

**PLUG COMPATIBLE WITH:** 2300A Scanner Mainframe

**OPERATING MODE:** Remote Control by 2300A



## Option -002

# Thermocouple Scanner Card

602-1. The Thermocouple Scanner Card, Option -002, is a 10 channel, 1 microvolt, scanner card for use in either the Model 2300A Scanner Mainframe or the Model 2301A Scanner Extender. The Thermocouple Scanner Card will accept inputs from low voltage measurement devices (thermocouples), and may be used with instruments such as the Fluke Model 2190A Digital Thermometer. Input information is received through 10 pairs of input terminals mounted on an isothermal block. A transistor, also mounted on the isothermal block, provides a reference signal in proportion to the isothermal block temperature.

602-2. Two sets of dual inline switches provide the operator with the means to select specific channels to be skipped upon initialization, and a method of establishing the correct linerization programming for the specific thermocouple type in use. The Scanner Control PCB microcomputer in the 2300A Scanner Mainframe, through operator controls on the front panel, controls all scan and channel skip functions for the Thermocouple Scanner Card.

### 602-3. SPECIFICATIONS

602-4. The Thermocouple Scanner Card meets all environmental specifications given for the Model 2300A Scanner Mainframe. Additional specifications applicable to the Thermocouple Scanner Card are listed in Table 602-1.

### 602-5. INSTALLATION

#### NOTE

*Some Model 2190A Digital thermometers require a software update for use with the Thermocouple Scanner Card. If, upon power-up, your thermometer displays 2190.1, 2190.2, or 2190.3, the software update is required for operation with the scanner. The update consists of a replacement IC for the thermometer, and a replacement IC for the Digital Output Unit (Option -002), if the option is in use. Software update ICs will be supplied at no cost to the customer; contact your nearest Fluke Technical Service Center for further information. In addition, the thermocouple input assembly must be installed in the 2190A with open input connections, and all segments of switch S1 in the off position.*

602-6. Option -002, the Thermocouple Scanner Card, is both factory and field installable. The following procedure is used to install the Thermocouple Scanner Card in either a Model 2300A Scanner Mainframe or a Model 2301A Scanner Extender.

1. Switch instrument power OFF.
2. Disconnect all input power lines.

**Table 602-1. Specifications**

|                                                                                                                        |
|------------------------------------------------------------------------------------------------------------------------|
| <b>CHANNEL RELAYS:</b> 10 very low Thermal-EMF Relays                                                                  |
| <b>POLES/CHANNEL:</b> 2                                                                                                |
| <b>MAX INPUT VOLTAGE:</b> 170V dc; 170V ac Peak                                                                        |
| <b>MAX COMMON MODE VOLTAGE:</b> 350V dc; 350V ac Peak between any two channels or between any channel and the chassis. |
| <b>THERMAL OFFSET ERROR:</b> 1 $\mu$ V Maximum.                                                                        |

3. To release the existing scanner option card, or the blank cover panel on the rear of the instrument, pull the black release buttons.
4. Pull the existing scanner option card out partially, and disconnect any existing inputs.
5. Remove the existing scanner option card.
6. Connect the input devices to the isothermal block on the Thermocouple Scanner Card being installed.
  - a. Pull the two cover latches out slightly to release them.
  - b. Lift the cover.
  - c. Connect the input wires to the screw-terminal pairs. (Refer to Figure 602-1.)
  - d. Close the isothermal block cover with the connecting wires positioned to pass through the slot provided.

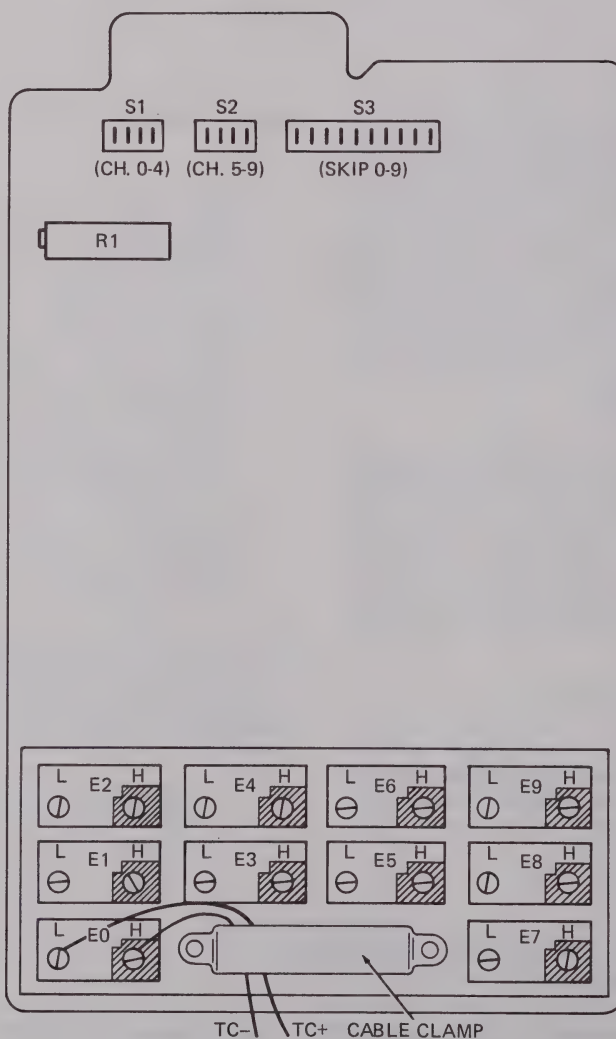


Figure 602-1. Thermocouple Connection

7. Select the desired channels to be skipped or enabled. (Refer to the operating instructions).
8. Push the Thermocouple Scanner Card completely into the scanner card slot to engage the motherboard connector.
9. Push the two black release buttons in to secure the Thermocouple Scanner Card in the instrument chassis.
10. Reconnect all input power lines.
11. Refer to the applicable instrument operating procedure.

## 602-7. OPERATING INSTRUCTIONS

602-8. Model 2300A Scanner Mainframe operating instructions remain valid with the Thermocouple Scanner Card installed. However, the operator can select skip or enable functions for all Thermocouple Scanner Card channels prior to installation. The skip enable and function enable switches are read by the scanner control microcomputer in the 2300A Scanner Mainframe, and the information is stored in memory for use during operation.

## 602-9. Function Enable Switches

602-10. The Thermocouple Scanner Card is designed primarily for use with thermocouple-type inputs. The function enable switches allow the operator to select a code. The microcomputer on the Scanner Control PCB in the 2300A Scanner Mainframe reads the Selector Bus (SB) lines and transfers the code established on those lines by the function enable switches to a Fluke Model 2190A Digital Thermometer, if one is in use. This selects the proper linerization program for the thermocouple type connected. Instruments other than the Model 2190A Digital Thermometer may not use the linerization codes.

Table 602-2, lists the various thermocouples and the function enable switch code for each. Two function enable switches are provided to control the thermocouple linerization for two 5-channel groups of inputs. Group one, controlled by switch S1, is composed of the first 5 channels (E0 through E4), and the second group, controlled by switch S2 is composed of the second 5 channels (E5 through E9). The codes listed in Table 602-2 are applicable to either input group and either function enable switch.

## 602-11. Skip Enable Switches

602-12. Switch S3, the skip enable switch, establishes the initial skip condition for each individual scanner channel. This skip condition may be changed through front panel controls during operation. To select a channel to be initially skipped, place the corresponding switch segment (0 through 9) in the ON position. Upon initialization, the scanner control microcomputer checks the Selector Bus (SB) lines during the time Skip Enable (SE) is true and stores the initial skip programming information.

## 602-13. THEORY OF OPERATION

## 602-14. Overall Functional Description

602-15. The Thermocouple Scanner Card, Option -002, is a 10-channel, 1 microvolt, scanner card designed primarily to provide temperature scanning capability when used in conjunction with the Fluke Model 2190A Digital Thermometer. It will, however, accept other voltage inputs signals. Two four-segment switches within the Thermocouple Scanner Card allow the operator to select the proper linerization curve. An additional 10-segment switch allows the operator to establish a skip condition for each individual channel prior to operation. The channel skip condition may be changed through front panel controls at any time during operation.

Table 602-2. Function Enable Switch Settings

| SELECTION<br>CODE | SWITCH POSITIONS |     |     |     | T/C TYPE 1      | T/C TYPE 2      | T/C TYPE 3      |
|-------------------|------------------|-----|-----|-----|-----------------|-----------------|-----------------|
|                   | 1                | 2   | 3   | 4   |                 |                 |                 |
| 0                 | OFF              | OFF | OFF | OFF | J               | J               | J din           |
| 1                 | ON               | OFF | OFF | OFF | K               | K               | K               |
| 2                 | OFF              | ON  | OFF | OFF | T               | —               | T din           |
| 3                 | ON               | ON  | OFF | OFF | —               | E               | —               |
| 4                 | OFF              | OFF | ON  | OFF | C               | —               | B               |
| 5                 | ON               | OFF | ON  | OFF | —               | S               | —               |
| 6                 | OFF              | ON  | ON  | OFF | R               | R               | R               |
| 7                 | ON               | ON  | ON  | OFF | Display Blanked | Display Blanked | Display Blanked |

602-16. Thermocouple Scanner Card circuitry comprises three functional sections as shown in Figure 602-2. Each circuit section performs one function necessary to overall Thermocouple Scanner Card operation. The skip enable section produces the required Selector Bus line states to establish the initial skip or unskip condition for each individual channel; the function enable section produces the required Selector Bus signal line states to establish the correct thermocouple linerization curve for the thermocouple in use. All 10 scanner channels are read in sequence through the reed relay circuit section.

602-17. An additional circuit within the reed-relay circuit section provides an output representative of the temperature at the thermocouple connection points on the isothermal block. This reference voltage is used within the Model 2190A Digital Thermometer to correct the thermocouple input and provide a direct temperature indication without the use of a ice bath reference. Other low thermal EMF instruments may not use the reference circuit.

602-18. Block Diagram Analysis

602-19. Function and Skip Enable Circuits

602-20. Although the purpose of the Skip Enable circuit and the Function enable circuit is different, the two circuits are identical in operation. The functional block diagram given in Figure 602-3, is typical of both circuits. Skip enable circuitry consists of 10 buffers, 10 switch segments, and 10 skip enable lines from the switches to the Selector Bus (SB) lines. Upon initialization, the microcomputer sets Skip Enable (SE) true. Through the buffers, any switch in the closed position supplies a ground-level signal on the associated SB line. The microcomputer reads the SB lines while the SE signal is true, and it stores the information received. Those lines that were at a low level when the microcomputer read them will be skipped during each scan cycle unless the skip condition is modified through front panel operator inputs. Operator inputs through the front panel affect only the microcomputer circuitry; conditions on the Thermocouple Scanner Card are not affected by front panel inputs.

602-21. Function enable circuitry operation is identical to skip enable circuit operation: the function enable buffers supply a ground level signal through each closed switch segment when they are enabled by a Function Enable (FE) signal true condition. The function enable switches, however, are separated into two groups of four segments each. Each group establishes a 4-bit code which determines the linerization formula for use with the five scanner channels associated with that switch. The 4-bit code set on each switch is read by the microcomputer

during the time that FE is held true. The microcomputer then transfers the code information to the Model 2190A Digital Thermometer, through the interface option, and the 2190A microcomputer uses the linerization formula programmed in ROM (Read Only Memory) for that code.

602-22. Each of the function enable switch-segment groups selects the linerization formula for use with five of the 10 scanner card channels. Each group may be set to a separate code, or they may be set to the same code if all input thermocouples are the same type. Table 602-2 lists the proper switch code for various thermocouple types.

602-23. Reed Relay Circuit

602-24. Reed Relays mounted on the Thermocouple Scanner Card switch from one input to the next at the direction of the Scanner Control microcomputer. Each input device, a thermocouple or other low thermal EMF input, is connected to screw terminals mounted on an isothermal block. Connection between the input device and the two output lines (TC- and TC+) is made through reed relays. All inputs use the same two output lines.

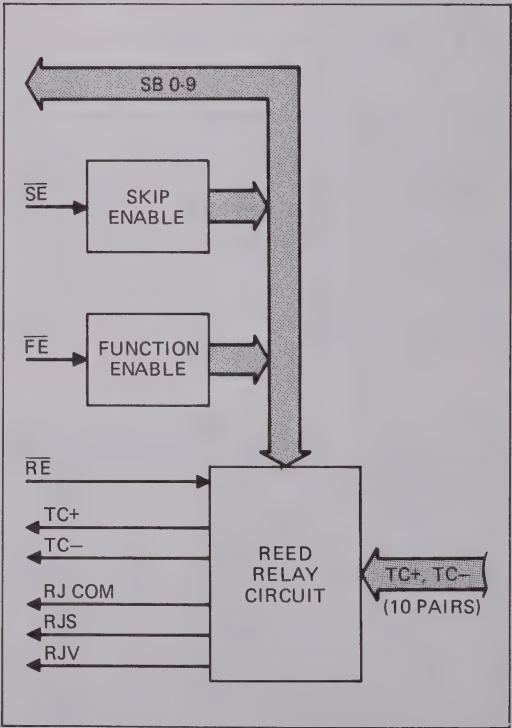


Figure 602-2. Thermocouple Scanner Card Functional Sections



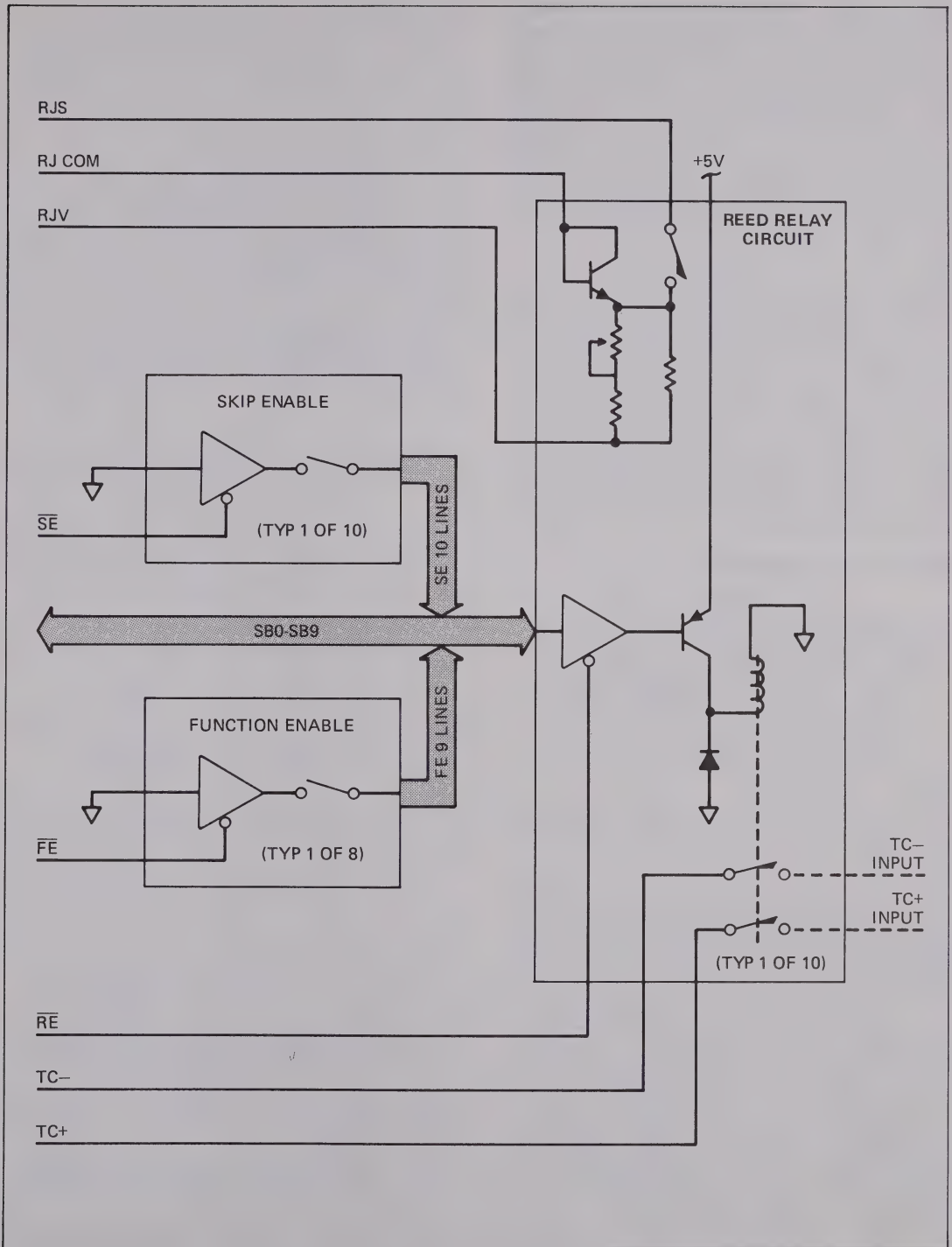


Figure 602-3. Thermocouple Scanner Block Diagram

602-25. During a typical scan cycle, the microcomputer will first read the skip enable and function enable switches, then set relay enable (RE) true. With RE true, each Selector Bus (SB) line is set true in sequence. When an SB line is set true, a transistor is switched on through a buffer, and that particular relay is energized. Information from the selected input is routed to the test instrument through the interface option. If a Model 2190A Digital Thermometer is in use with one of the appropriate thermocouples, the proper linerization curve is applied to the input information in the digital thermometer circuitry.

602-26. An additional circuit mounted on the isothermal block compensates for errors induced by ambient temperature variations. A transistor temperature sensor mounted on the isothermal block is maintained at the same temperature as the input connections (by the isothermal block). Thermocouple voltages introduced by the dissimilar metals at the input terminals vary as the isothermal block adjusts to ambient temperature. The transistor senses temperature changes and produces a correction voltage, which is used within the analog circuitry of the 2190A Digital Thermometer to correct the thermocouple input.

602-27. MAINTENANCE

WARNING

THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN THE OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

602-28. Introduction

602-29. This section provides service, maintenance, performance test, and calibration adjustment information. The calibration procedure must be performed each time a repair is made or the thermocouple probe is changed. A list of required test equipment is given in Table 602-3. If the specified equipment is not available, alternate equipment with comparable specifications may be used.

Table 602-3. Recommended Test Equipment

| EQUIPMENT TYPE    | RECOMMENDED MODEL     |
|-------------------|-----------------------|
| Scanner Mainframe | Fluke Model 2300A     |
| Interface Option  | Fluke Model 2300A-005 |
| Input Device      | Thermocouple, k Type  |
| Cable Accessories | Fluke Y7203, Y7204    |
| Test Instrument   | Fluke Model 2190A     |
| DMM               | Fluke Model 8000A     |
| Oscilloscope      | Tektronics 7603       |

602-30. SERVICE INFORMATION

602-31. General service information, cleaning instruction, and warranty information contained in Section 4 of this manual is applicable to the Thermocouple Scanner Card.

602-32. PERFORMANCE TEST

602-33. The performance test is performed with the Thermocouple Scanner Card installed in a Model 2300A Scanner Mainframe. A Model 2190A Digital Thermometer should be connected to the Scanner Mainframe to test the reference junction compensation circuit and function select code switches. A thermocouple of a type listed in Table 602-2 should be connected at the thermocouple Scanner Card inputs. The performance test follows:

1. Install the Thermocouple Scanner Card in a known-good 2300A Scanner Mainframe. (Refer to the installation instructions.)
2. Connect a known-good thermocouple to the input connections and a known-good Model 2190A Digital Thermometer to the 2300A Scanner Mainframe. (Refer to 2300A Scanner Mainframe installation procedures.)
3. Switch power on to both the scanner mainframe and the digital thermometer.
4. Manually scan all channels using the 2300A Scanner Mainframe front panel controls.
5. If the Thermocouple Scanner Card is operating correctly, the digital thermometer will display information from each channel. If the Thermocouple Scanner Card is defective, refer to the troubleshooting procedure in this section.

602-34. Calibration Adjustment

602-35. Before performing the Thermocouple Scanner Card calibration procedure, verify accuracy of the required Model 2190A Digital Thermometer by performing the digital thermometer calibration procedure, or the digital thermometer performance test. The following procedure must be used to insure scanner card accuracy after any repair, or each time the thermocouple type is changed:

1. Connect a thermocouple to input terminal E0 on the Thermocouple Scanner Card.
2. Install the Thermocouple Scanner Card in a Scanner Mainframe.

3. Connect a 2190A Digital Thermometer to the Scanner Mainframe as described in the 2300A Scanner Mainframe installation instructions.
4. Select the proper switch code for the thermocouple in use.
5. Insert the thermocouple and an accurate (Plus or minus .01 degree) mercury thermometer in a lag bath. (See lag bath construction procedure.)
6. Select the proper scanner channel using the 2300A Scanner Mainframe front panel controls.
7. Allow the system to stabilize, then adjust potentiometer R1 on the Thermocouple Scanner Card to obtain a temperature display on the digital Thermometer equal to the mercury thermometer indication.
8. Repeat steps 1 through 6 for the remaining scanner channels to verify correct operation.

### 602-36. Lag Bath Construction

602-37. The following instructions provide a recommended lag bath construction method.

1. Required materials: an acceptable thermocouple probe, a mercury thermometer (.01 degree resolution), and an insulated jar with an unbreakable lid (Thermos or equivalent).
2. Drill two holes in the insulated jar's lid (or other fitting) just large enough to allow insertion of the thermometer and thermocouple.
3. Fill the jar with room temperature water, and attach the lid containing the probe and thermometer. The probe and thermometer should be immersed as far as possible without touching the container bottom.
4. Allow 20 minutes for the lag bath temperature to stabilize before performing calibration procedures.

### 602-38. Selected Component Replacement and Adjustment Procedure

602-39. Certain components in the reference junction compensation circuit are selected and individually matched at the factory to provide maximum accuracy in compensation output. If it is necessary to repair or replace the reference junction transistor (Q1), or resistors R1, R2, or R3, the selected component replacement and adjustment procedure must be performed to insure accurate ambient temperature compensation.

602-40. Prior to performing the following matching procedure, verify Model 2190A Digital Thermometer calibration and 2300A Scanner Mainframe calibration, as well as Thermocouple Scanner Card calibration. Substitute the selected component replacement and adjustment procedure for the Thermocouple Scanner Card calibration procedure.

1. Connect the thermocouple to Thermocouple Scanner input E0.
2. Select the proper function select switch code. (Refer to Table 602-2.)
3. Install the Thermocouple Scanner Card in the 2300A Scanner Mainframe.
4. Connect a Model 2190A Digital Thermometer to the 2300A Scanner Mainframe.
5. Switch power on to the 2300A Scanner Mainframe and the Digital Thermometer.
6. Center the reference junction potentiometer (R1).
7. Connect a resistance decade box in place of the reference junction bias resistor (R3).
8. Adjust the decade box to the resistance value from Table 602-4 that produces a digital thermometer indication closest to that of the mercury thermometer.
9. Remove power, disconnect the decade box, and install the selected resistor.
10. Reapply power and allow the system to stabilize (minimum of 20 minutes).

Table 602-4. Bias Resistor Values

| VALUE | JOHN FLUKE<br>PART NUMBER | VALUE | JOHN FLUKE<br>PART NUMBER |
|-------|---------------------------|-------|---------------------------|
| 49.9k | 268821                    | 110k  | 234708                    |
| 52.3k | 237248                    | 124k  | 288407                    |
| 54.9k | 271353                    | 140k  | 289439                    |
| 57.6k | 289116                    | 162k  | 375998                    |
| 60.4k | 291419                    | 191k  | 375923                    |
| 63.4k | 235382                    | 237k  | 288373                    |
| 68.1k | 236828                    | 309k  | 235283                    |
| 73.2k | 237222                    | 332k  | 289504                    |
| 78.7k | 289058                    | 464k  | 271908                    |
| 84.5k | 229492                    | 562k  | 235358                    |
| 90.9k | 223537                    | 1.05M | 260737                    |
| 100k  | 248807                    | ∞     | OPEN                      |

11. Adjust the potentiometer to obtain a digital thermometer display identical to the mercury thermometer indication.

12. Component selection and calibration is complete. Disconnect all test equipment.

## 602-41. Troubleshooting

602-42. Troubleshooting procedures detailed in Table 602-5 should be performed only after isolating a possible malfunction to the Thermocouple Scanner Card. The table is designed to assist in isolating a malfunction to the

component level. The table is arranged as a tabular flow chart. When a step in the table is completed, check for a decision transfer. If no decision is required, perform the next step in the table in sequence.

## 602-43. LIST OF REPLACEABLE PARTS

602-44. Table 602-6 contains an illustrated parts breakdown of the Thermocouple Scanner Card. Components are listed by reference designator; each component listed is shown in an accompanying illustration. Parts ordering information is available in Section 5 of the Scanner Mainframe manual.

Table 602-5. Troubleshooting Guide

| STEP NO. | ACTION                                                                                       | Go to the step number given for correct response |    |
|----------|----------------------------------------------------------------------------------------------|--------------------------------------------------|----|
|          |                                                                                              | YES                                              | NO |
| 1.       | Install the Thermocouple Scanner Card in a Scanner Mainframe.                                |                                                  |    |
| 2.       | Connect all inputs and the digital thermometer as detailed in the installation instructions. |                                                  |    |
| 3.       | Switch mainframe power on.                                                                   |                                                  |    |
| 4.       | Do the function enable switches produce the proper codes?                                    | 6                                                | 5  |
| 5.       | Check the function enable switches and buffers.                                              |                                                  |    |
| 6.       | Can all channels be selected for skip condition?                                             | 8                                                | 7  |
| 7.       | Check the skip select switches and buffers.                                                  |                                                  |    |
| 8.       | Are all channels scanned and information from each displayed?                                | 10                                               | 9  |
| 9.       | Check the reed relays and associated transistors.                                            |                                                  |    |
| 10.      | Can the reference junction circuit be adjusted as detailed in the calibration procedure?     | 12                                               | 11 |
| 11.      | Check the reference junction transistor, relay, and resistors.                               |                                                  |    |
| 12.      | Repeat the performance test to verify proper operation.                                      |                                                  |    |



Table 602-6. Thermocouple Scanner PCB Assembly

| REF<br>DES | DESCRIPTION                                                  | FLUKE<br>STOCK<br>NO. | MFG<br>SPLY<br>CODE | MFG PART NO.<br>OR TYPE | TOT<br>QTY | REC<br>QTY | N<br>O<br>T<br>E |
|------------|--------------------------------------------------------------|-----------------------|---------------------|-------------------------|------------|------------|------------------|
| -002       | ⊗ THERMOCOUPLE SCANNER PCB ASSY<br>FIGURE 602-4 (2300A-4020) | 2300A                 | ORDER               | OPTION -002             |            |            |                  |
| C1         | CAP, TA, 10 UF +/-20%, 20V                                   | 330662                | 56289               | 196D106X0020KA1         | 1          |            |                  |
| CR1        | DIODE, SI, HI-SPEED SWITCHING                                | 203323                | 07910               | 1N4448                  | 11         | 3          |                  |
| CR10       | DIODE, SI, HI-SPEED SWITCHING                                | 203323                | 07910               | 1N4448                  | REF        |            |                  |
| CR11       | DIODE, SI, HI-SPEED SWITCHING                                | 203323                | 07910               | 1N4448                  | REF        |            |                  |
| CR12       | DIODE, SI, HI-SPEED SWITCHING                                | 203323                | 07910               | 1N4448                  | REF        |            |                  |
| CR13       | DIODE, SI, HI-SPEED SWITCHING                                | 203323                | 07910               | 1N4448                  | REF        |            |                  |
| CR14       | DIODE, SI, HI-SPEED SWITCHING                                | 203323                | 07910               | 1N4448                  | REF        |            |                  |
| CR15       | DIODE, SI, HI-SPEED SWITCHING                                | 203323                | 07910               | 1N4448                  | REF        |            |                  |
| CR16       | DIODE, SI, HI-SPEED SWITCHING                                | 203323                | 07910               | 1N4448                  | REF        |            |                  |
| CR17       | DIODE, SI, HI-SPEED SWITCHING                                | 203323                | 07910               | 1N4448                  | REF        |            |                  |
| CR18       | DIODE, SI, HI-SPEED SWITCHING                                | 203323                | 07910               | 1N4448                  | REF        |            |                  |
| H1         | SCREW, FHP, 4-40 X 1/2                                       | 149047                | 89536               | 149047                  | 2          |            |                  |
| H2         | SCREW, FHP, 4-40 X 5/8                                       | 241349                | 89536               | 241349                  | 6          |            |                  |
| H3         | SCREW, FHP, 4-40 X 1/2                                       | 152132                | 89536               | 152132                  | 3          |            |                  |
| H4         | SCREW, FHP, 6-32 X 5/16                                      | 152157                | 89536               | 152157                  | 22         |            |                  |
| J10        | CONNECTOR, POST                                              | 513861                | 00779               | 1-87022-7               | 1          |            |                  |
| K10        | RELAY COIL ASSEMBLY                                          | 535054                | 89536               | 535054                  | 10         |            |                  |
| K11        | RELAY COIL ASSEMBLY                                          | 535054                | 89536               | 535054                  | REF        |            |                  |
| K12        | RELAY COIL ASSEMBLY                                          | 535054                | 89536               | 535054                  | REF        |            |                  |
| K13        | RELAY COIL ASSEMBLY                                          | 535054                | 89536               | 535054                  | REF        |            |                  |
| K14        | RELAY COIL ASSEMBLY                                          | 535054                | 89536               | 535054                  | REF        |            |                  |
| K15        | RELAY COIL ASSEMBLY                                          | 535054                | 89536               | 535054                  | REF        |            |                  |
| K16        | RELAY COIL ASSEMBLY                                          | 535054                | 89536               | 535054                  | REF        |            |                  |
| K17        | RELAY COIL ASSEMBLY                                          | 535054                | 89536               | 535054                  | REF        |            |                  |
| K18        | RELAY COIL ASSEMBLY                                          | 535054                | 89536               | 535054                  | REF        |            |                  |
| K19        | RELAY COIL ASSEMBLY                                          | 535054                | 89536               | 535054                  | REF        |            |                  |
| K20        | RELAY, DRY REED                                              | 357582                | 71707               | UF-40070                | 1          |            |                  |
| MP1        | BLOCK, ISOTHERMAL                                            | 503870                | 89536               | 503870                  | 1          |            |                  |
| MP2        | BRACKET, HINGE                                               | 515320                | 89536               | 515320                  | 1          |            |                  |
| MP3        | CLAMP, CABLE                                                 | 531228                | 89536               | 531228                  | 1          |            |                  |
| MP4        | COIL, PCB                                                    | 502856                | 89536               | 502856                  | 1          |            |                  |
| MP5        | COVER, HIGH VOLTAGE                                          | 515346                | 89536               | 515346                  | 1          |            |                  |
| MP6        | DECAL, -002 OPTION                                           | 495572                | 89536               | 495572                  | 1          |            |                  |
| MP7        | DECAL, THERMOCOUPLE WARNING                                  | 524694                | 89536               | 495572                  | 1          |            |                  |
| MP8        | GUARD, COPPER                                                | 515338                | 89536               | 515338                  | 1          |            |                  |
| MP9        | GROMMET                                                      | 519827                | 83014               | HN4C-43-5               | 2          |            |                  |
| MP10       | INSULATOR, HIGH VOLTAGE                                      | 515304                | 89536               | 515304                  | 1          |            |                  |
| MP11       | INSULATOR, ISOTHERMAL                                        | 503888                | 89536               | 503888                  | 1          |            |                  |
| MP12       | INSULATOR, THERMAL                                           | 503961                | 89536               | 503961                  | 1          |            |                  |
| MP13       | PLUNGER                                                      | 519835                | 89536               | 519835                  | 2          |            |                  |
| P10        | CONNECTOR, RECEPTACLE                                        | 267476                | 00779               | 85861-2                 | 11         |            |                  |
| Q1         | XSTR, SI, NPN                                                | 329698                | 12040               | 2N2484                  | 1          | 1          |                  |
| Q2         | XSTR, SI, PNP                                                | 195974                | 04713               | 2N3906                  | 11         | 3          |                  |
| Q3         | XSTR, SI, NPN                                                | 218396                | 04713               | 2N3904                  | 1          | 1          |                  |
| Q10        | XSTR, SI, PNP                                                | 195974                | 04713               | 2N3906                  | REF        |            |                  |
| Q11        | XSTR, SI, PNP                                                | 195974                | 04713               | 2N3906                  | REF        |            |                  |
| Q12        | XSTR, SI, PNP                                                | 195974                | 04713               | 2N3906                  | REF        |            |                  |

Table 602-6. Thermocouple Scanner PCB Assembly (cont)

| REF<br>DES | DESCRIPTION                                | FLUKE<br>STOCK<br>NO. | MFG<br>SPLY<br>CODE | MFG PART NO.<br>OR TYPE | TOT<br>QTY | REC<br>QTY | N<br>O<br>T<br>E |
|------------|--------------------------------------------|-----------------------|---------------------|-------------------------|------------|------------|------------------|
| Q13        | XSTR, SI, PNP                              | 195974                | 04713               | 2N3906                  | REF        |            |                  |
| Q14        | XSTR, SI, PNP                              | 195974                | 04713               | 2N3906                  | REF        |            |                  |
| Q15        | XSTR, SI, PNP                              | 195974                | 04713               | 2N3906                  | REF        |            |                  |
| Q16        | XSTR, SI, PNP                              | 195974                | 04713               | 2N3906                  | REF        |            |                  |
| Q17        | XSTR, SI, PNP                              | 195974                | 04713               | 2N3906                  | REF        |            |                  |
| Q18        | XSTR, SI, PNP                              | 195974                | 04713               | 2N3906                  | REF        |            |                  |
| Q19        | XSTR, SI, PNP                              | 195974                | 04713               | 2N3906                  | REF        |            |                  |
| R1         | RES, VAR, 50K +/-10%, 1/2W                 | 330688                | 75378               | 190PC503B               | 1          |            |                  |
| R2         | RES, MTL. FILM, 187K +/-1%, 1/8W           | 291641                | 91637               | CMF551873F              | 1          |            |                  |
| R5         | RES, DEP. CAR, 100K +/-5%, 1/4W            | 348920                | 80031               | CR251-4-5P100K          | 2          |            |                  |
| R6         | RES, DEP. CAR, 4.7K +/-5%, 1/4W            | 348821                | 80031               | CR251-4-5P4K7           | 1          |            |                  |
| R7         | RES, DEP. CAR, 100K +/-5%, 1/4W            | 348920                | 80031               | CR251-4-5P100K          | REF        |            |                  |
| R8         | RES, DEP. CAR, 0.5 +/-5%, 1/4W             | 381954                | 80031               | CR251-4-5P0.5E          | 1          |            |                  |
| R9         | RES, DEP. CAR, 820 +/-5%, 1/8W             | 442327                | 80031               | CR251-4-5P820E          | 1          |            |                  |
| S1         | SWITCH ASSEMBLY                            | 408559                | 00779               | 435166-2                | 2          |            |                  |
| S2         | SWITCH ASSEMBLY                            | 408559                | 00779               | 435166-2                | REF        |            |                  |
| S3         | SWITCH, MODULE                             | 504878                | 00779               | 435166-7                | 1          |            |                  |
| S10        | REED SWITCH ASSEMBLY                       | 516401                | 89536               | 516401                  | 10         |            |                  |
| S11        | REED SWITCH ASSEMBLY                       | 516401                | 89536               | 516401                  | REF        |            |                  |
| S12        | REED SWITCH ASSEMBLY                       | 516401                | 89536               | 516401                  | REF        |            |                  |
| S13        | REED SWITCH ASSEMBLY                       | 516401                | 89536               | 516401                  | REF        |            |                  |
| S14        | REED SWITCH ASSEMBLY                       | 516401                | 89536               | 516401                  | REF        |            |                  |
| S15        | REED SWITCH ASSEMBLY                       | 516401                | 89536               | 516401                  | REF        |            |                  |
| S16        | REED SWITCH ASSEMBLY                       | 516401                | 89536               | 516401                  | REF        |            |                  |
| S17        | REED SWITCH ASSEMBLY                       | 516401                | 89536               | 516401                  | REF        |            |                  |
| S18        | REED SWITCH ASSEMBLY                       | 516401                | 89536               | 516401                  | REF        |            |                  |
| S19        | REED SWITCH ASSEMBLY                       | 516401                | 89536               | 516401                  | REF        |            |                  |
| TP1        | TEST POINT                                 | 512889                | 89536               | 512889                  | 1          |            |                  |
| U1         | ⊗ IC, C-MOS, TRI-STATE, HEX, NONINV, BFFRS | 407759                | 12040               | MM80C97N                | 5          |            | 1                |
| U2         | ⊗ IC, C-MOS, TRI-STATE, HEX, NONINV, BFFRS | 407759                | 12040               | MM80C97N                | REF        |            |                  |
| U3         | ⊗ IC, C-MOS, TRI-STATE, HEX, NONINV, BFFRS | 407759                | 12040               | MM80C97N                | REF        |            |                  |
| U4         | ⊗ IC, C-MOS, TRI-STATE, HEX, NONINV, BFFRS | 407759                | 12040               | MM80C97N                | REF        |            |                  |
| U5         | ⊗ IC, C-MOS, TRI-STATE, HEX, NONINV, BFFRS | 407759                | 12040               | MM80C97N                | REF        |            |                  |
| Z1         | RESISTOR NETWORK, 10K                      | 364000                | 89536               | 364000                  | 2          |            |                  |
| Z2         | RESISTOR NETWORK, 10K                      | 364000                | 89536               | 364000                  | REF        |            |                  |
| Z3         | RESISTOR NETWORK, 100K                     | 461038                | 89536               | 461038                  | 1          |            |                  |

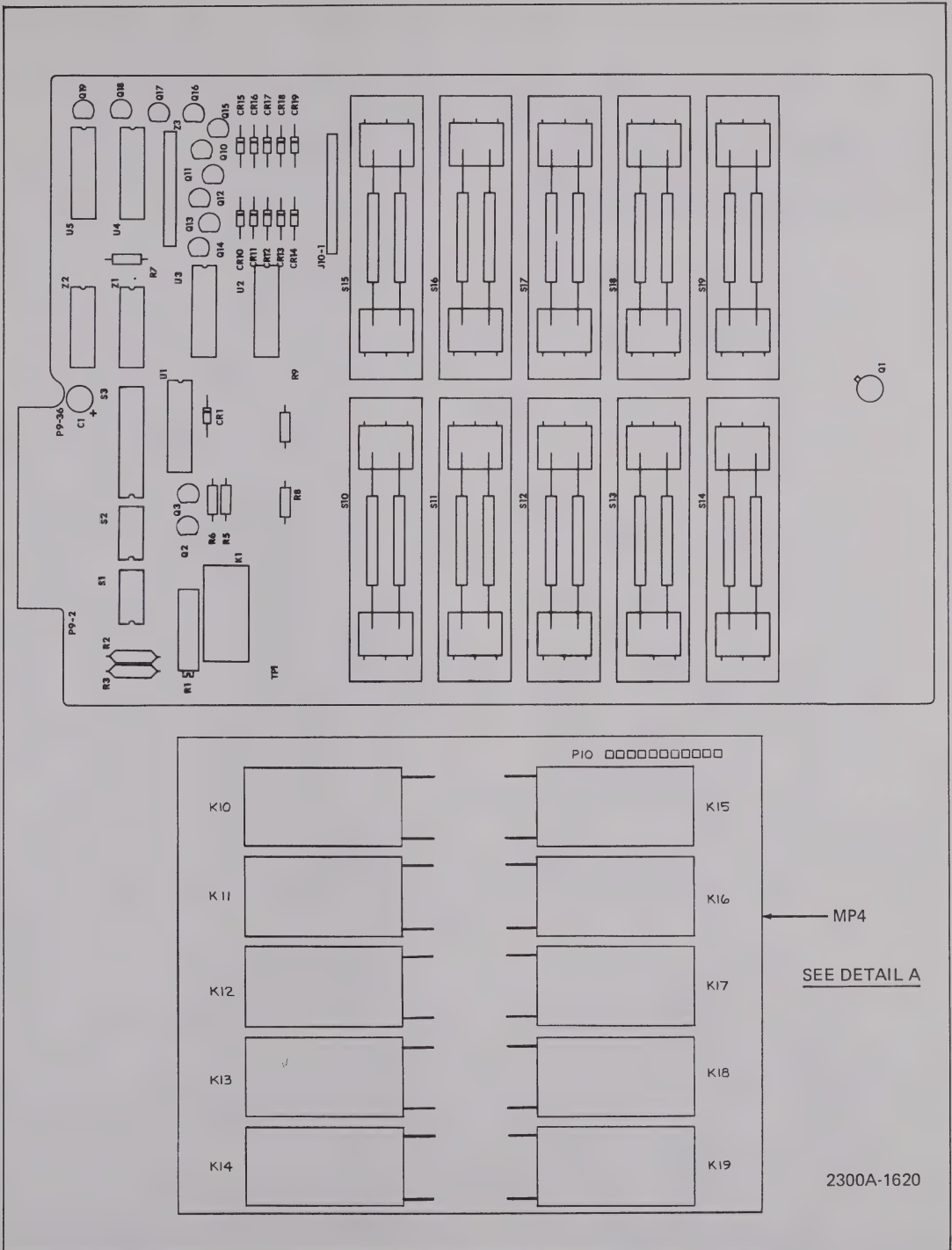
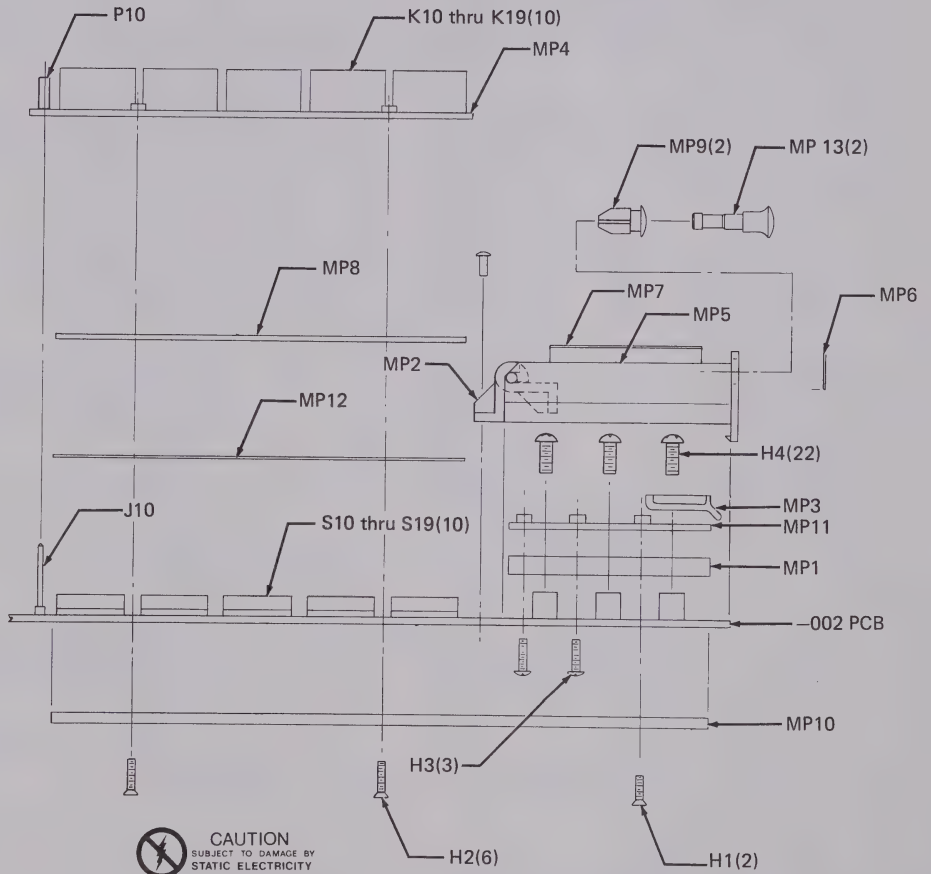


Figure 602-4. Thermocouple Scanner PCB Assembly



DETAIL A

2300A-4020

Figure 602-4. Thermocouple Scanner PCB Assembly (cont)



# Option -003

## RTD/OHMS Scanner Card

### 603-1. INTRODUCTION

603-2. The RTD (Resistive Temperature Detector)/Ohms Scanner Card, Option -003, is a 10 channel scanner card for use in either the Model 2300A Scanner Mainframe or the Model 2301A Scanner Extender. It will accept inputs from an RTD type temperature sensor or other resistive type sensing device. The RTD/Ohms Scanner Card is designed primarily for use with the Fluke Model 2180A Digital Thermometer, or similar devices. Input information is received through 10, 4-terminal inputs. Switches are provided to select any channel to be skipped in the automatic scan mode, and additional switches provide a means of selecting different linerization functions for different RTD probe types. Analog output terminals are provided for use with interface options that require them.

603-3. Two sets of dual inline switches provide the operator with the means to select specific channels to be skipped upon initialization, and a method of establishing the correct linerization programming for the specific RTD sensor type in use. The Scanner Control PCB microcomputer in the scanner mainframe, through operator controls on the front panel, controls all scan and channel skip functions for the RTD/Ohms Scanner card.

### 603-4. SPECIFICATIONS

603-5. The RTD/Ohms Scanner Card meets all environmental specifications given for the Model 2300A Scanner Mainframe. Additional specifications applicable to the RTD/Ohms Scanner Card are listed in Table 603-1.

Table 603-1. Specifications

|                                           |
|-------------------------------------------|
| CHANNEL RELAYS: 10 Low Thermal-EMF Relays |
| POLES/CHANNEL: 3                          |
| MAX INPUT VOLTAGE: 30V dc; 30V ac Peak    |

### 603-6. INSTALLATION

#### NOTE

*Some Model 2180A Digital Thermometers require a software update for use with the RTD/Ohms Scanner Card. If, upon power-up, your thermometer displays 2180.1, the software update is required for use with a scanner. The software update consists of a replacement IC for the thermometer, and a replacement IC for the Digital Output Unit (Option -002), if the option is in use. Software update ICs will be supplied at no cost to the customer; contact your nearest Fluke Technical Service Center for further information.*

603-7. Option -003 is both factory and field installable. The following procedure may be used to install the RTD/Ohms Scanner Card in either a Model 2300A Scanner Mainframe or a Model 2301A Scanner Extender:

1. Switch instrument power off.
2. Disconnect all input power lines.
3. To release the existing scanner option card, or the blank cover panel on the rear of the instrument, pull the black release buttons.
4. Pull the existing scanner option card out partially, and disconnect any existing inputs.
5. Remove the existing scanner option card.
6. Connect the input devices to the input terminal blocks.

- a. Pull the two cover latches out slightly to release them.
  - b. Lift the cover.
  - c. Connect the input wires to the screw-terminal connections. (Refer to Figure 603-1 and Figure 603-2.)
  - d. Close the isothermal block cover with the connecting wires positioned to pass through the slot provided.
  - e. Perform the calibration procedure for each channel. (Refer to the calibration procedure given in this manual section.)
7. Select the desired channels to be skipped or enabled. (Refer to the Operating instructions.)
  8. Push the RTD/Ohms Scanner Card completely into the scanner card slot to engage the motherboard connector.
  9. Push in the two black release buttons to secure the RTD/Ohms Scanner Card in the instrument chassis.
  10. Reconnect all input power lines.
  11. Refer to the applicable instrument operating procedure.

### 603-8. OPERATING INSTRUCTIONS

603-9. Model 2300A Scanner Mainframe operating instructions remain valid with the RTD/Ohms Scanner Card installed. However, the operator can select skip or enable functions for all RTD/Ohms Scanner Card channels prior to installation. The skip enable switches are read upon initialization by the scanner control microcomputer in the 2300A Scanner Mainframe, and the information is stored in memory for use during operation.

### 603-10. Function Enable Switches

603-11. The RTD/Ohms Scanner Card is designed primarily for use with RTD-type temperature inputs. The function enable switches allow the operator to select a code. The microcomputer on the Scanner Control PCB in the 2300A Scanner Mainframe reads the Selector Bus (SB) lines and transfers the information established on those lines by the function enable switches to a Fluke Model 2180A Digital Thermometer to select the proper linerization program for the RTD-type connected. The scanner does not check the last bit in the code established by the switches, therefore, voltage measurements can not be selected using the function select switches. Instruments other than the Model 2180A Digital Thermometer may not use the linerization codes. Table 603-2 lists the various

RTD sensors and the function enable switch code for each. Two function enable switches are provided to control the thermocouple linerization for two, 5-channel groups of inputs. Group one, controlled by switch S1, is composed of the first 5 channels (0 through 4), and group two, controlled by switch S2, is composed of the second 5 channels (5 through 9). The codes listed in Table 603-2 are applicable to either input group and either function enable switch.

### 603-12. Skip Enable Switches

603-13. Switch S3, the skip enable switch, establishes the initial skip condition for each individual scanner channel. This skip condition may be changed through front panel controls during operation. To select a channel to be initially skipped, place the corresponding switch segment (1 through 10) in the ON position. Upon initialization, the microcomputer checks the Selector Bus (SB) lines during the time Skip Enable (SE) is true and stores the initial skip programming information. The skip programming is used only in automatic or remote operation.

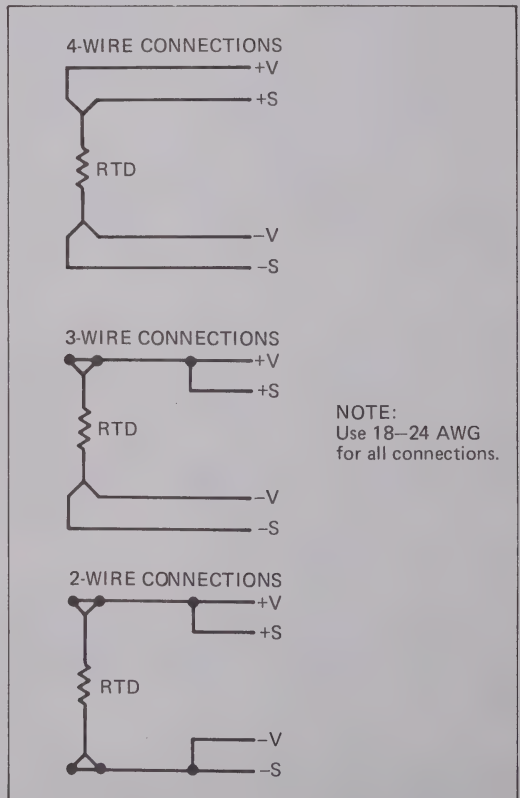


Figure 603-1. RTD Connections

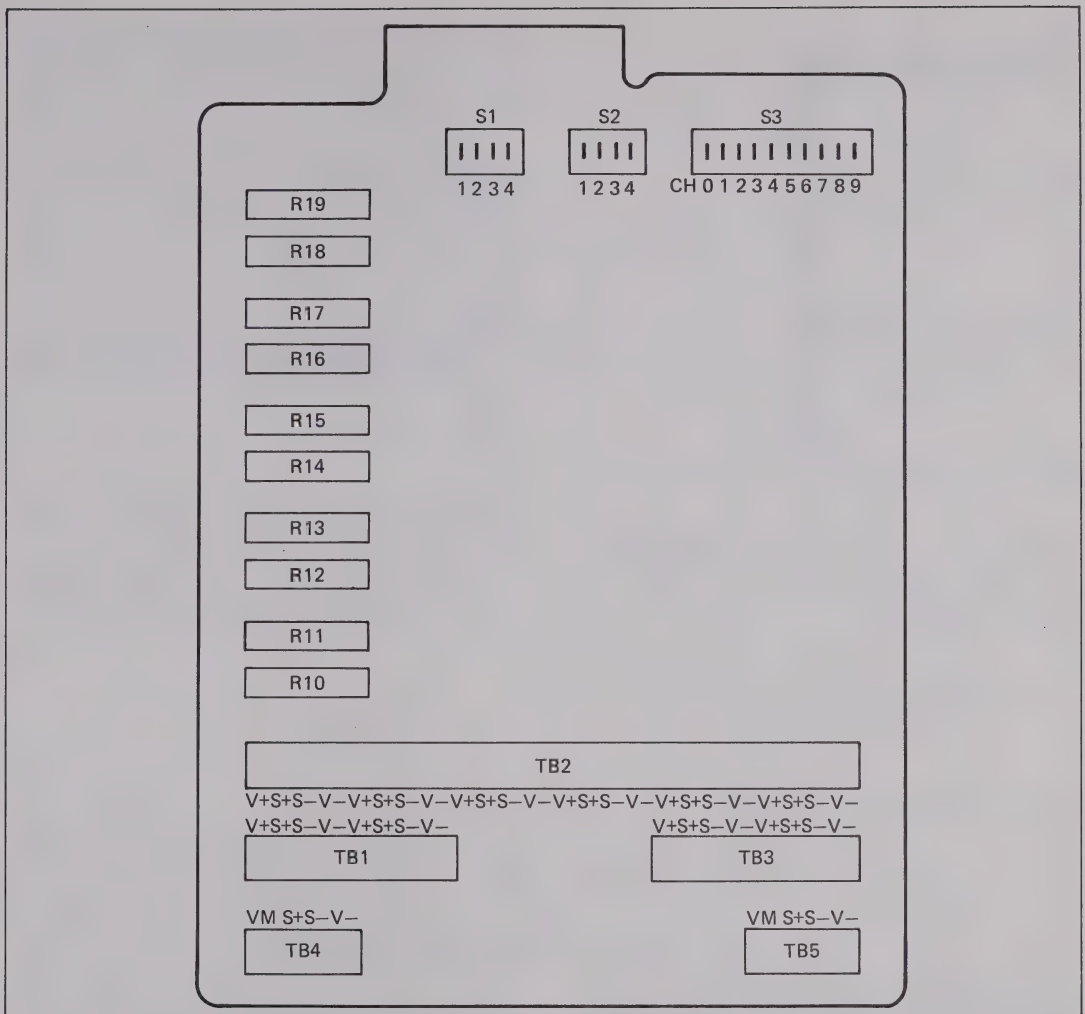


Figure 603-2. RTD Connections

Table 603-2. RTD Function Switch Codes

| SELECTION CODE | RTD TYPE | SWITCH SEGMENT |     |     |     |
|----------------|----------|----------------|-----|-----|-----|
|                |          | 1              | 2   | 3   | 4   |
| 0              | 385 Pt   | OFF            | OFF | OFF | OFF |
| 1              | 390 Pt   | ON             | OFF | OFF | OFF |
| 2              | 3916 Pt  | OFF            | ON  | OFF | OFF |
| 3              | 392 Pt   | ON             | ON  | OFF | OFF |
| 4              | 100ΩNi   | OFF            | OFF | ON  | OFF |
| 5              | 10ΩCu    | ON             | OFF | ON  | OFF |

## 603-14. THEORY OF OPERATION

### 603-15. Overall Functional Description

603-16. RTD/Ohms Scanner Card circuitry comprises three functional sections as shown in Figure 603-3. Each circuit section performs one function necessary to overall RTD/Ohms Scanner Card operation. The skip enable section produces the required Selector Bus signal line states to establish the initial skip or unskip condition for each individual channel; the function enable section produces the required Selector Bus signal line states to establish the correct linerization curve for the RTD probe in use. All 10 scanner channels are read in sequence through the reed relay circuit section.

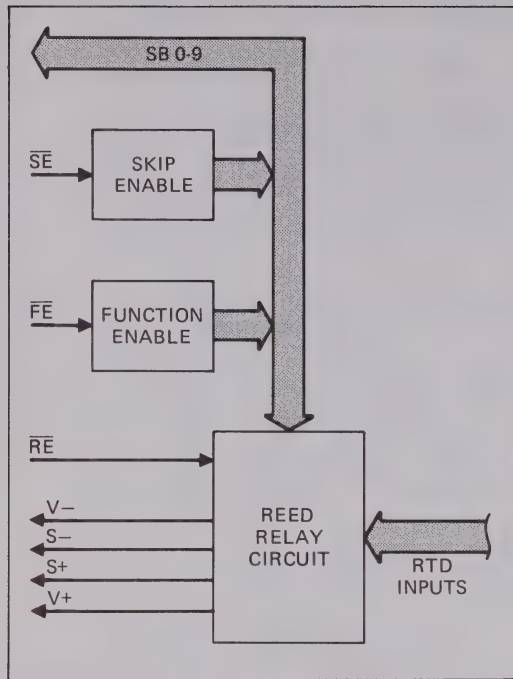


Figure 603-3. RTD/Ohms Scanner Card  
Functional Sections

### 603-17. Block Diagram Analysis

#### 603-18. FUNCTION AND SKIP ENABLE CIRCUITS

603-19. Although the purpose of the skip enable circuit and the function enable circuit is different, the two circuits are identical in operation. The functional block diagram given in Figure 603-4 is typical of both circuits. Skip enable circuitry consists of 10 buffers, 10 switch segments, and 10 skip enable lines from the switches to the Selector Bus (SB) lines from the microcomputer. Upon initialization, the microcomputer sets Skip Enable (SE) true. Through the buffers, any switch in the closed position supplies a ground-level signal on the SB line to which it is connected. The microcomputer reads the SB lines while the SE signal is true, and it stores the information received. Those lines that were at a low level when the microcomputer reads them will be skipped during each scan cycle unless the skip condition is modified through front panel operator inputs. Operator inputs through the front panel effect only the microcomputer; circuitry and conditions on the RTD/Ohms Scanner Card are not effected by front panel inputs.

603-20. Function enable circuit operation is identical to skip enable circuit operation: the function enable buffers supply a ground level signal through each closed switch segment when they are enabled by a Function Enable (FE) signal true condition. The function enable switches, however, are separated into two groups of four segments each. Each four-segment group establishes a 4-bit code which determines the linerization formula for use with the five scanner channels associated with that switch. The 4-bit code set on each switch is read by the microcomputer during the time that FE is held true. The microcomputer then transfers the code information to the Model 2180A Digital Thermometer, through the interface option, and the 2180A microcomputer uses the linerization formula programmed in ROM (Read Only Memory) for that code.

603-21. Each of the function enable switch-segment groups selects the linearization formula for use with five of the 10 scanner card channels. Each group may be set to a separate code, or they may be set to the same code if all input RTD sensors are the same type. Table 603-2 lists the proper switch code for various RTD sensor types.

#### 603-22. REED RELAY CIRCUIT

603-23. Reed relays mounted on the RTD/Ohms Scanner Card switch from one input to the next at the direction of the microcomputer. Each input device, an RTD or other resistive type input device, is connected to screw terminals mounted on the pcb. Each scanner channel input circuit contains a potentiometer which must be adjusted to compensate for varying lead resistance each time the connected RTD probe is changed. Refer to the calibration adjustment. Connection between the input device and the four output lines (V-, S-, S+, and Vm) is made through a reed relay. All inputs use the same four output lines.

603-24. During a typical scan cycle, the microcomputer will first read the skip enable and function enable switches, then set relay enable (RE) true. With RE true, each Selector Bus (SB) line is set true in sequence. When a SB line is set true, a transistor is switched on through a buffer, and that particular relay is energized. Information from the selected input is routed to the test instrument through the interface option. If a Model 2180A Digital Thermometer is in use with one of the appropriate RTD probes, the proper linerization curve is applied to the input information in the Digital Thermometer circuitry.



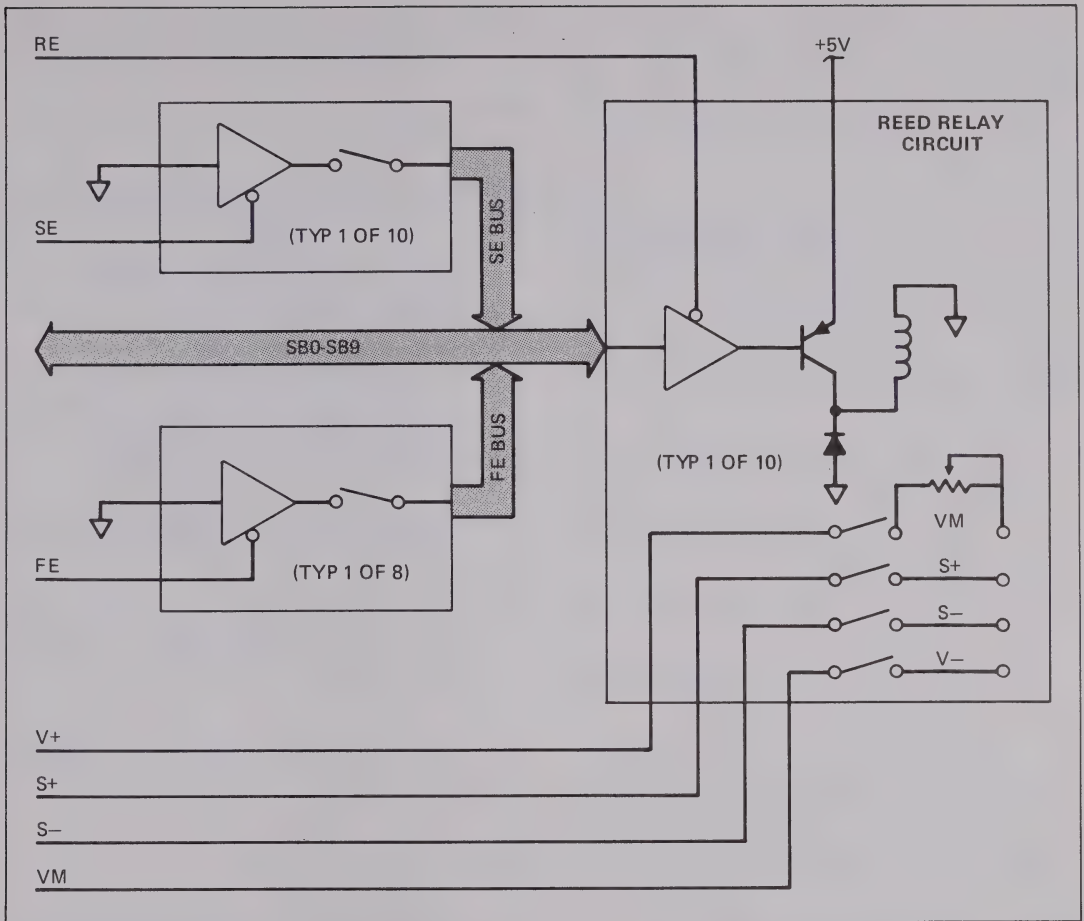


Figure 603-4. RTD/Ohms Scanner Card Block Diagram

## 603-25. MAINTENANCE

### WARNING

THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN THE OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

## 603-26. INTRODUCTION

603-27. This section provides service, maintenance, performance test, and calibration adjustment information. The calibration procedure must be performed each time a repair is made or the RTD probe is

changed. Table 603-3 lists the recommended test equipment. If the equipment listed is not available, test equipment with comparable specifications may be substituted.

Table 603-3. Recommended Test Equipment

| EQUIPMENT TYPE    | RECOMMENDED MODEL     |
|-------------------|-----------------------|
| Scanner Mainframe | Fluke Model 2300A     |
| Interface Option  | Fluke Model 2300A-005 |
| Input Device      | RTD Probe             |
| Cable Accessories | Fluke Y7203, Y7204    |
| Test Instrument   | Fluke Model 2180A     |
| DMM               | Fluke Model 8000A     |
| Oscilloscope      | Tektronics 7603       |

## 603-28. Service Information

603-29. General service information, cleaning instructions, and warranty information contained in Section 4 of the Model 2300A Scanner Mainframe manual is applicable to the RTD/Ohms Scanner Card.

## 603-30. Performance Test

603-31. RTD/Ohms Scanner Card performance test is performed with the scanner card installed in a Model 2300A Scanner Mainframe. A Model 2180A Digital Thermometer should be connected to the Scanner Mainframe to verify linerization program selection. An RTD type probe must be connected to each input for performance testing. Use the following procedure to performance test the RTD/Ohms Scanner Card:

1. Install the RTD/Ohms Scanner Card in a known-good Scanner Mainframe. (Refer to the Installation Instructions.)
2. Connect a Model 2180A Digital Thermometer to the scanner mainframe.
3. Connect a known-good RTD probe to each scanner channel input.
4. Switch power on to both the 2300A Scanner Mainframe and the digital thermometer.
5. Manually increment the scanner through all channels using the manual front panel switch.
6. If the RTD/Ohms Scanner Card is operating properly, the digital thermometer will display information from each channel in sequence.

## 603-32. Calibration Adjustment

603-33. The following calibration procedure must be performed after RTD/Ohms Scanner Card repair and each time the RTD probe in use is changed:

1. Connect the RTD probe to the input terminal block.
2. Select the applicable switch setting on the function enable switches (Refer to Table 603-2.)
3. Install the RTD/Ohms Scanner Card in a 2300A Scanner Mainframe.
4. Connect a 2180A Digital Thermometer to the 2300A Scanner Mainframe.
5. Insert the probe in a ice bath (refer to ice bath construction procedures).

6. Adjust the appropriate potentiometer (R10 through R19) to obtain a digital thermometer display of 0°C or 32°F.

7. Repeat the calibration procedure for each channel.

## 603-34. Ice Bath Construction Procedure

### NOTE

*Distilled water must be used to make the ice and must be used in the ice bath.*

603-35. The following instructions provide a recommended ice bath construction method:

1. Required material: an acceptable RTD probe, a supply of ice and an insulated jar with an unbreakable lid (Thermos or equivalent).
2. Drill one hole in the insulated jar's lid (or other fitting) just large enough to allow insertion of the RTD Probe.
3. Fill the jar with cold water and ice, and attach the lid containing the probe. The probe should be immersed as far as possible without touching the container bottom.
4. Allow 20 minutes for the temperature displayed to stabilize before performing calibration procedures.

## 603-36. Troubleshooting

603-37. Troubleshooting procedures detailed in Table 603-4, should be performed only after isolating a possible malfunction to the RTD/Ohms Scanner Card. The table is designed to assist in isolating a malfunction to the component level. The table is arranged as a tabular flow chart. When a step in the table is completed, check for a decision transfer. If no decision is required, perform the next step in the table in sequence.

## 603-38. LIST OF REPLACEABLE PARTS

603-39. Table 603-5, contains an illustrated parts breakdown of the RTD/Ohms Scanner Card. Components are listed by reference designator; each component listed is shown in an accompanying illustration. Parts ordering information is available in Section 5 of the Scanner Mainframe manual.

### CAUTION



Indicated devices are subject to damage by static discharge.

Table 603-4. Troubleshooting Guide

| STEP<br>NO. | ACTION                                                                                           | Go to the step<br>number given<br>for correct<br>response |    |
|-------------|--------------------------------------------------------------------------------------------------|-----------------------------------------------------------|----|
|             |                                                                                                  | YES                                                       | NO |
| 1.          | Install the RTD/Ohms Scanner Card in a Scanner Mainframe.                                        |                                                           |    |
| 2.          | Connect all inputs and the Digital Thermometer as detailed in the installation instructions.     |                                                           |    |
| 3.          | Switch mainframe power on.                                                                       |                                                           |    |
| 4.          | Do the function enable switches produce the proper codes?                                        | 6                                                         | 5  |
| 5.          | Check the function enable switches and buffers.                                                  |                                                           |    |
| 6.          | Can all channels be selectively skipped?                                                         | 8                                                         | 7  |
| 7.          | Check the skip select switches and buffers.                                                      |                                                           |    |
| 8.          | Are all channels scanned in sequence and information from each displayed on the test instrument? | 10                                                        | 9  |
| 9.          | Check the reed relays and associated transistors and buffers.                                    |                                                           |    |
| 10.         | Can each channel be calibrated as detailed in the calibration procedures?                        | 12                                                        | 11 |
| 11.         | Check the appropriate potentiometers.                                                            |                                                           |    |
| 12.         | Repeat the performance test to verify proper operation.                                          |                                                           |    |

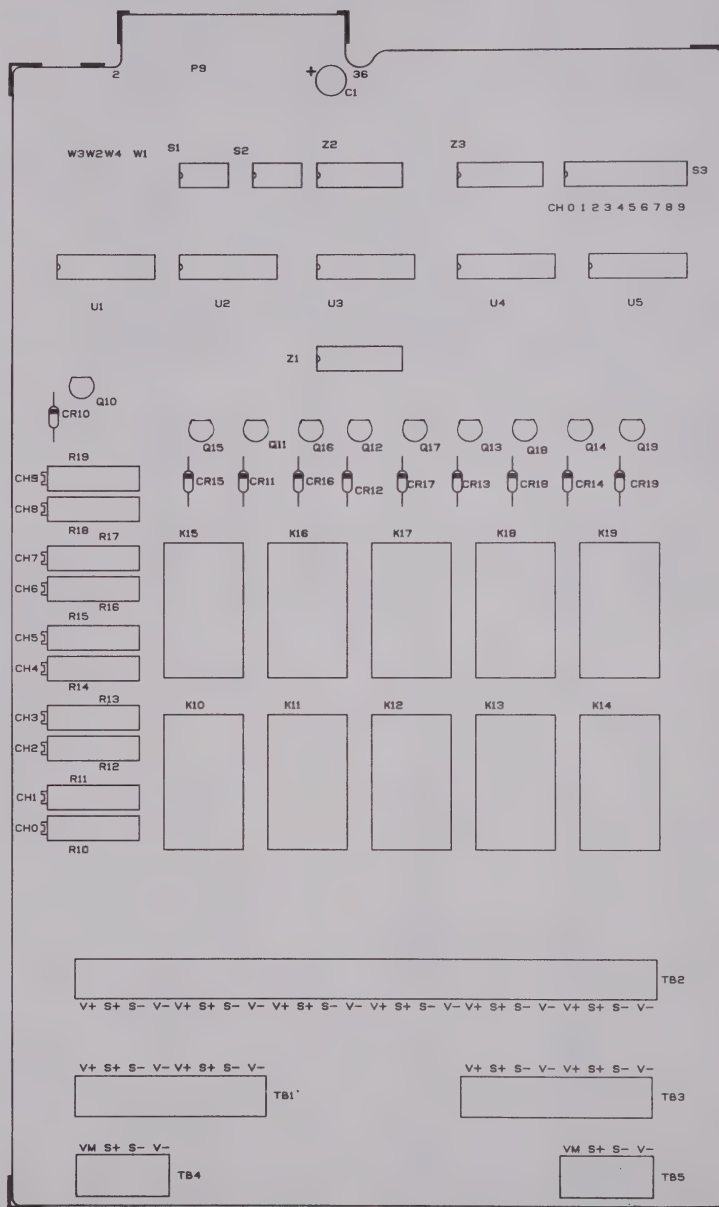
Table 603-5. RTD/OHMS Scanner PCB Assembly

| REF<br>DES | DESCRIPTION                                                  | FLUKE<br>STOCK<br>NO. | MFG<br>SPLY<br>CODE | MFG PART NO.<br>OR TYPE | TOT<br>QTY | REC<br>QTY | N<br>O<br>T<br>E |
|------------|--------------------------------------------------------------|-----------------------|---------------------|-------------------------|------------|------------|------------------|
| -003       | ⊙RTD/OHMS SCANNER PCB ASSEMBLY<br>FIGURE 603-5 (2300A-4030T) | 2300A                 | ORDER               | OPTION -003             |            |            |                  |
| C1         | CAP, TA, 10 UF +/-20%, 20V                                   | 330662                | 56289               | 196D106X0020KA1         | 1          |            |                  |
| CR10       | DIODE, HI-SPEED SWITCHING                                    | 203323                | 07910               | 1N4448                  | 10         | 2          |                  |
| CR11       | DIODE, HI-SPEED SWITCHING                                    | 203323                | 07910               | 1N4448                  |            | REF        |                  |
| CR12       | DIODE, HI-SPEED SWITCHING                                    | 203323                | 07910               | 1N4448                  |            | REF        |                  |
| CR13       | DIODE, HI-SPEED SWITCHING                                    | 203323                | 07910               | 1N4448                  |            | REF        |                  |
| CR14       | DIODE, HI-SPEED SWITCHING                                    | 203323                | 07910               | 1N4448                  |            | REF        |                  |
| CR15       | DIODE, HI-SPEED SWITCHING                                    | 203323                | 07910               | 1N4448                  |            | REF        |                  |
| CR16       | DIODE, HI-SPEED SWITCHING                                    | 203323                | 07910               | 1N4448                  |            | REF        |                  |
| CR17       | DIODE, HI-SPEED SWITCHING                                    | 203323                | 07910               | 1N4448                  |            | REF        |                  |
| CR18       | DIODE, HI-SPEED SWITCHING                                    | 203323                | 07910               | 1N4448                  |            | REF        |                  |
| CR19       | DIODE, HI-SPEED SWITCHING                                    | 203323                | 07910               | 1N4448                  |            | REF        |                  |
| H1         | SCREW, PHP, 4-40 X 3/8                                       | 152124                | 73734               | 19024                   |            | 2          |                  |
| K10        | RELAY, DRY REED                                              | 484444                | 21317               | E51AX4                  |            | 10         |                  |
| K11        | RELAY, DRY REED                                              | 484444                | 21317               | E51AX4                  |            | REF        |                  |
| K12        | RELAY, DRY REED                                              | 484444                | 21317               | E51AX4                  |            | REF        |                  |
| K13        | RELAY, DRY REED                                              | 484444                | 21317               | E51AX4                  |            | REF        |                  |
| K14        | RELAY, DRY REED                                              | 484444                | 21317               | E51AX4                  |            | REF        |                  |
| K15        | RELAY, DRY REED                                              | 484444                | 21317               | E51AX4                  |            | REF        |                  |
| K16        | RELAY, DRY REED                                              | 484444                | 21317               | E51AX4                  |            | REF        |                  |
| K17        | RELAY, DRY REED                                              | 484444                | 21317               | E51AX4                  |            | REF        |                  |
| K18        | RELAY, DRY REED                                              | 484444                | 21317               | E51AX4                  |            | REF        |                  |
| K19        | RELAY, DRY REED                                              | 484444                | 21317               | E51AX4                  |            | REF        |                  |
| MP1        | COVER, HIGH VOLTAGE                                          | 515346                | 89536               | 515346                  |            | 1          |                  |
| MP2        | DECAL, CHANNEL ID. (NOT SHOWN)                               | 524751                | 89536               | 524751                  |            | 1          |                  |
| MP3        | DECAL, -003 OPTION                                           | 495580                | 89536               | 495580                  |            | 1          |                  |
| MP4        | GROMMET                                                      | 519827                | 89536               | 519827                  |            | 2          |                  |
| MP5        | HINGE, BRACKET                                               | 515320                | 89536               | 515320                  |            | 1          |                  |
| MP6        | INSERT, SILICONE (NOT SHOWN)                                 | 525089                | 89536               | 525089                  |            | 1          |                  |
| MP7        | PLUNGER                                                      | 519835                | 89536               | 519835                  |            | 2          |                  |
| MP8        | RETAINER, FLEX (NOT SHOWN)                                   | 514935                | 89536               | 514935                  |            | 1          |                  |
| Q10        | XSTR, SI, PNP                                                | 195974                | 04713               | 2N3906                  |            | 10         | 2                |
| Q11        | XSTR, SI, PNP                                                | 195974                | 04713               | 2N3906                  |            | REF        |                  |
| Q12        | XSTR, SI, PNP                                                | 195974                | 04713               | 2N3906                  |            | REF        |                  |
| Q13        | XSTR, SI, PNP                                                | 195974                | 04713               | 2N3906                  |            | REF        |                  |
| Q14        | XSTR, SI, PNP                                                | 195974                | 04713               | 2N3906                  |            | REF        |                  |
| Q15        | XSTR, SI, PNP                                                | 195974                | 04713               | 2N3906                  |            | REF        |                  |
| Q16        | XSTR, SI, PNP                                                | 195974                | 04713               | 2N3906                  |            | REF        |                  |
| Q17        | XSTR, SI, PNP                                                | 195974                | 04713               | 2N3906                  |            | REF        |                  |
| Q18        | XSTR, SI, PNP                                                | 195974                | 04713               | 2N3906                  |            | REF        |                  |
| Q19        | XSTR, SI, PNP                                                | 195974                | 04713               | 2N3906                  |            | REF        |                  |
| R10        | RES, VAR, 500 +/-20%, 1/2W                                   | 267849                | 11236               | 190RC501B               |            | 10         |                  |
| R11        | RES, VAR, 500 +/-20%, 1/2W                                   | 267849                | 11236               | 190RC501B               |            | REF        |                  |
| R12        | RES, VAR, 500 +/-20%, 1/2W                                   | 267849                | 11236               | 190RC501B               |            | REF        |                  |
| R13        | RES, VAR, 500 +/-20%, 1/2W                                   | 267849                | 11236               | 190RC501B               |            | REF        |                  |
| R14        | RES, VAR, 500 +/-20%, 1/2W                                   | 267849                | 11236               | 190RC501B               |            | REF        |                  |
| R15        | RES, VAR, 500 +/-20%, 1/2W                                   | 267849                | 11236               | 190RC501B               |            | REF        |                  |
| R16        | RES, VAR, 500 +/-20%, 1/2W                                   | 267849                | 11236               | 190RC501B               |            | REF        |                  |



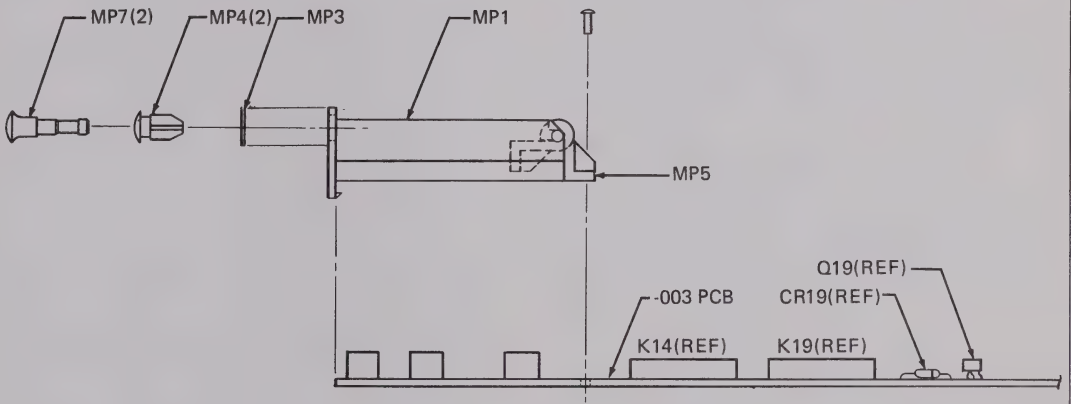
Table 603-5. RTD/OHMS Scanner PCB Assembly (cont)

| REF<br>DES | DESCRIPTION                               | FLUKE<br>STOCK<br>NO. | MFG<br>SPLY<br>CODE | MFG PART NO.<br>OR TYPE | TOT<br>QTY | REC<br>QTY | N<br>O<br>T<br>E |
|------------|-------------------------------------------|-----------------------|---------------------|-------------------------|------------|------------|------------------|
| R17        | RES, VAR, 500 +/-20%, 1/2W                | 267849                | 11236               | 190RC501B               | REF        |            |                  |
| R18        | RES, VAR, 500 +/-20%, 1/2W                | 267849                | 11236               | 190RC501B               | REF        |            |                  |
| R19        | RES, VAR, 500 +/-20%, 1/2W                | 267849                | 11236               | 190RC501B               | REF        |            |                  |
| S1         | SWITCH ASSEMBLY, 4-SPST                   | 408559                | 00779               | 435166-2                | 2          |            |                  |
| S2         | SWITCH ASSEMBLY, 4-SPST                   | 408559                | 00779               | 435166-2                | REF        |            |                  |
| S3         | SWITCH, MODULE, 10-POS.                   | 504878                | 00779               | 435166-7                | 1          |            |                  |
| TB1        | TERMINAL STRIP, 8-POS                     | 518878                | 89536               | 518878                  | 2          |            |                  |
| TB2        | TERMINAL STRIP, 24 POS                    | 520866                | 89536               | 520866                  | 1          |            |                  |
| TB3        | TERMINAL STRIP, 8-POS                     | 518878                | 89536               | 518878                  | REF        |            |                  |
| TB4        | TERMINAL STRIP, 4-POS                     | 520841                | 89536               | 520841                  | 2          |            |                  |
| TB5        | TERMINAL STRIP, 4-POS                     | 520841                | 89536               | 520841                  | REF        |            |                  |
| U1         | ⊗IC, C-MOS, TRI-STATE, HEX, NONINV, BFFRS | 407759                | 12040               | MM80C97N                | 5          |            | 1                |
| U2         | ⊗IC, C-MOS, TRI-STATE, HEX, NONINV, BFFRS | 407759                | 12040               | MM80C97N                | REF        |            |                  |
| U3         | ⊗IC, C-MOS, TRI-STATE, HEX, NONINV, BFFRS | 407759                | 12040               | MM80C97N                | REF        |            |                  |
| U4         | ⊗IC, C-MOS, TRI-STATE, HEX, NONINV, BFFRS | 407759                | 12040               | MM80C97N                | REF        |            |                  |
| U5         | ⊗IC, C-MOS, TRI-STATE, HEX, NONINV, BFFRS | 407759                | 12040               | MM80C97N                | REF        |            |                  |
| W1         | WIRE JUMPER                               | 529206                | 89536               | 529206                  | 4          |            |                  |
| W2         | WIRE JUMPER                               | 529206                | 89536               | 529206                  | REF        |            |                  |
| W3         | WIRE JUMPER                               | 529206                | 89536               | 529206                  | REF        |            |                  |
| W4         | WIRE JUMPER                               | 529206                | 89536               | 529206                  | REF        |            |                  |
| XW1-XW4    | SOCKET (W1 THRU W4)                       | 376418                | 89536               | 376418                  | 8          |            |                  |
| Z1         | RESISTOR NETWORK, 100K                    | 404624                | 89536               | 404624                  | 1          |            |                  |
| Z2         | RESISTOR NETWORK, 10K                     | 364000                | 89536               | 364000                  | 2          |            |                  |
| Z3         | RESISTOR NETWORK, 10K                     | 364000                | 89536               | 364000                  | REF        |            |                  |
| Z3.        | INSTRUCTION SHEET (-003)                  | 522102                | 89536               | 522102                  | 1          |            |                  |

SEE  
DETAIL 1

2300A-1630

Figure 603-5. RTD/OHMS Scanner PCB Assembly



DETAIL 1

2300A-4030

Figure 603-5. RTD/OHMS Scanner PCB Assembly (cont)





Option -005  
Interface (2180A/2190A)

605-1. INTRODUCTION

605-2. Interface Option -005, the 2180A/2190A Digital Thermometer interface, is a microcomputer controlled interface that allows the 2300A Scanner Mainframe to operate as a temperature scanner with either the Thermocouple Scanner Card (Option -002) or the RTD/Ohms Scanner Card (Option -003) installed in the mainframe. Interface circuitry transfers analog data received by each scanner channel to the digital thermometer, and it transfers thermocouple type identification information and reference junction compensation data to the thermometer. The interface receives digital output data from the thermometer, reformats that data into the proper format, then transfers the thermometer data to a printer to produce a permanent record. In addition, it supplies an RS-232-C data output.

605-3. The Interface (2180A/2190A) installs in the Scanner mainframe, and communicates with the Scanner Control PCB through a 22-pin, inline connector mounted on a ribbon cable. Communication with the digital thermometer is through the 25-pin, cable mounted connector; communication with the Model 2020A or 2030A Printer is through a 36-pin connector on the scanner rear panel. The cable-mounted thermometer connector extends from the 2300A Scanner Mainframe rear panel just above the Data I/O connector.

605-4. SPECIFICATIONS

605-5. The Interface (2180A/2190A) meets all environmental specifications given for the Model 2300A Scanner Mainframe. Additional specifications applicable to the Interface (2180A/2190A) are listed in Table 605-1.

605-6. INSTALLATION

605-7. Option -005, the Interface (2180A/2190A) is factory installable only. The following procedure may be used to install the Interface option in a Model 2300A Scanner Mainframe. Option -005 can not be installed in a Model 2301A Scanner Extender.

1. Switch 2300A power off.
2. Disconnect all input power and signal lines.
3. Release the scanner option cards by pulling the black buttons on the rear of each scanner option card.
4. Slide the scanner option cards out the rear of the Scanner Mainframe chassis.
5. Remove the four cover retaining screws in the bottom of the 2300A Scanner Mainframe case.

Table 605-1. Specifications

|                                                                                                                                                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>INTERFACE CAPABILITY:</b> Scanner to: 2180A or 2190A Digital Thermometer, and PTI Printer (2020A-001, 2020A-004, 2021A-001, 2021A-004, 2030A). |
| <b>THERMOMETER OUTPUT:</b> Optically isolated                                                                                                     |
| <b>PRINTER OUTPUT:</b> PTI standard Bit-parallel, character-serial ASCII. Addresses 1, 6, 7, 8, and 9.                                            |
| <b>THERMOMETER CONNECTOR:</b> Cable-mounted 25-pin male                                                                                           |
| <b>PRINTER CONNECTOR:</b> Board-mounted 36-pin female                                                                                             |
| <b>RS-232-C:</b> Output only: 110, 150, 300, 600, 1200, 2400, 4800, 9600 baud.                                                                    |

- 6. Lift the 2300A Scanner Mainframe case cover straight up to remove it.
- 7. Remove the four screws that secure the scanner card mounting bracket to the stand-offs on the Scanner Control PCB.
- 8. Remove the two screws that secure the mounting bracket to the Display/Keyboard PCB. Remove the scanner card mounting bracket.
- 9. Disconnect the ribbon cable from the current interface option, if one is present, then remove the four screws (one at each corner) that hold the interface board to the Scanner Control PCB stand-offs.
- 10. Place the Interface (2180A/2190A) on the stand-offs and replace the screws.
- 11. Select the desired PTI address and RS-232-C baud rate. (Refer to operating instructions.)
- 12. Connect the ribbon cable connector to the Scanner Control PCB.
- 13. Replace the scanner option card mounting bracket and the six screws that secure it.
- 14. Replace the scanner option cards and the 2300A Scanner Mainframe case cover.
- 15. Connect the applicable cables, inputs, and power connections (Refer to the 2300A Scanner Mainframe installation procedure and the appropriate scanner option card installation procedure.)

605-8. OPERATING INSTRUCTIONS

605-9. Model 2300A Scanner Mainframe operating instructions are valid for a 2300A Scanner Mainframe with the Interface (2180A/2190A) installed. However, one switch on the interface pcb allows the operator to select a PTI address for printer output, and a 4-segment, single-throw switch allows the operator to select any of 8 different baud rates for RS-232-C data output.

605-10. A printer connected to the interface will send nine different PTI addresses, in order to receive information from nine different source instruments, including a 2300A Scanner Mainframe. The printer address to which the interface will respond must be selected by the operator prior to installation. The interface will respond to any of the nine possible addresses, but the printer can produce intelligible output only if one of the printer addresses that transfers ASCII data using the handshake transfer mode is selected.

605-11. A Model 2020A or 2021A printer using the parallel ASCII printer interface requires printer address number 1 set through switch S2. The parallel ASCII interface can only send printer address number one. If a 2020A or 2021A Printer is connected using the PTI printer interface, or if a Model 2030A Printer is in use, then addresses 1, 6, 7, 8, and 9 are valid for use on the Interface (2180A/2190A) in the Scanner Mainframe. Refer to Table 605-2 for a list of switch positions and codes for each valid address. After selecting the proper address, install the interface in a 2300A Scanner Mainframe and operate it as instructed in Section 2 of this manual.

Table 605-2. Printer Addresses

| SWITCH |     |     |     | ADR. NO. | DATA TYPE/ TRANSFER MODE |
|--------|-----|-----|-----|----------|--------------------------|
| 1      | 2   | 3   | 4   |          |                          |
| OFF    | OFF | OFF | OFF | 0        |                          |
| OFF    | OFF | OFF | ON  | 1        | Parallel ASCII/Handshake |
| OFF    | OFF | ON  | OFF | 2        | BCD/Clocked              |
| OFF    | OFF | ON  | ON  | 3        | BCD/Clocked              |
| OFF    | ON  | OFF | OFF | 4        | BCD/Clocked              |
| OFF    | ON  | OFF | ON  | 5        | BCD/Clocked              |
| OFF    | ON  | ON  | OFF | 6        | Parallel ASCII/Handshake |
| OFF    | ON  | ON  | ON  | 7        | Parallel ASCII/Handshake |
| ON     | OFF | OFF | OFF | 8        | Parallel ASCII/Handshake |
| ON     | OFF | OFF | ON  | 9        | Parallel ASCII/Handshake |
| ON     | OFF | ON  | OFF | F        | None                     |

*NOTE: Only those addresses which transfer ASCII data in a handshake mode are valid for Option-005.*

605-12. Eight different baud rates are switch selectable for RS-232-C output. A 4-segment, single throw switch is used to establish a baud rate code for the microcomputer. All actual baud rate generation occurs within the microcomputer. The first three switch segments (1, 2, and 3) establish the code which tells the microcomputer which baud rate to use; segment 4 has no effect on the baud rate in the Option -005 interface. Refer to Table 605-3, for baud rate codes and switch position information.

Table 605-3. RS-232-C Baud Rate Selection

| BAUD RATE | SWITCH SEGMENTS |     |     |   |
|-----------|-----------------|-----|-----|---|
|           | 1               | 2   | 3   | 4 |
| 110       | OFF             | OFF | OFF | — |
| 150       | ON              | OFF | OFF | — |
| 300       | OFF             | ON  | OFF | — |
| 600       | ON              | ON  | OFF | — |
| 1200      | OFF             | OFF | ON  | — |
| 2400      | ON              | OFF | ON  | — |
| 4800      | OFF             | ON  | ON  | — |
| 9600      | ON              | ON  | ON  | — |

*NOTE: Segment 4 may be in either position.*

## 605-13. THEORY OF OPERATION

### 605-14. Overall Functional Description

605-15. Interface circuitry allows the 2300A Scanner Mainframe to communicate with the mainframe Scanner Control PCB, a digital thermometer, and a PTI system printer. It also provides a data output that conforms to the RS-232-C standard. The interface, as shown in Figure 605-1, consists of four distinct functional sections: the thermometer interface circuitry, the printer interface circuitry, the RS-232-C output circuitry, and the microcomputer that controls all interface functions.

605-16. Data and control signals from the Scanner Control PCB in the 2300A Scanner Mainframe are transferred to the interface microcomputer through buffers. Printer data and handshake signals are also transferred through buffers, but address decoding circuitry is also necessary to allow the interface to respond to only one printer address. Interface input and output signals to the digital thermometer are isolated through a guard circuit, and an address decoding circuit is also present to interpret the address from the digital thermometer. Control, address, and serial digital data to the thermometer goes through the guard circuit, but the analog data from each channel is bussed straight through the interface to the thermometer.

### 605-17. Block Diagram Analysis

605-18. Data from the Scanner Control PCB is transferred to the interface pcb microcomputer through a buffer. Data from the interface microcomputer is transferred to the scanner control PCB through a buffer. Three data transfer control lines (Acknowledge, Ready, and DVL) are also buffered. Data is received in the interface microcomputer on the data from line (from the scanner control microcomputer). Data is transmitted to the scanner control microcomputer on the DATA TO line.

605-19. Data is transferred to the interface microcomputer from the Scanner Control PCB in a bit-serial, handshake transfer mode. Refer to Figure 605-2, the Data In Transfer Sequence. The transfer sequence commences with the transfer lines in an idle, or wait state. In the wait state, the DATA TO line is at a high logic level, the DATA FROM line is low, the DVL line is high, the ACK line is low, and the RDY line is high. First, the scanner control microcomputer places valid data on the DATA FROM line. It then pulls the DVL line low to inform the interface microcomputer that valid data is available. After reading the data, the interface microcomputer sets the ACK line to a high logic level and the RDY line to a low logic level. When the ACK line goes high, the scanner control microcomputer removes data from the DATA FROM line, and returns the DVL signal to a high state. The interface microcomputer then pulls

the ACK line low again, and allows the RDY line to go high.

605-20. Data transfer from an interface option to the Scanner Control PCB microcomputer is also accomplished using a handshake data transfer sequence. A data transfer is initiated by the scanner control microcomputer; it sends an 8-bit data word on the DATA FROM line. The 8-bit data word addresses the interface (or an extender) and requests it to reply. The scanner control microcomputer then goes to the listen state by placing both DVL and DATA FROM high, as shown in Figure 605-3. With the microcomputer in the listen state, the addressed interface option can transfer data to the Scanner Control PCB. After the talk command is transferred, the addressed interface (or scanner extender) will pull the DATA TO line low signifying that it is ready to reply. When the scanner control microcomputer receives a low logic level on the DATA TO line, it then pulls DVL low. Shortly after DVL is set low, all extenders, since they are not replying, read the DATA FROM line (high), and release the ACK line, allowing it to go high. As they release the ACK line, they also pull the RDY line low. The interface then places data on the DATA TO line, and releases the ACK line, allowing it to go high. When the scanner control microcomputer sees ACK high and RDY low, it reads the DATA TO line, then sets DVL high. It also pulls DATA FROM low, indicating that it is not ready to receive an additional data bit. In response to the DVL high logic level, all unaddressed extenders release the RDY line, allowing it to go high, and pull ACK low. The responding interface then removes data from the DATA TO line and sets it high. It then releases the RDY line, allowing it to go high, and pulls ACK low, thereby re-entering the ready state. When the scanner control microcomputer is ready to receive the next data bit, it sets the DATA FROM line high and initiates another data bit handshake sequence. All data transfers are either single or multiple 8-bit data words.

### 605-21. RS-232-C DATA OUTPUT

605-22. A bit-serial data output conforming to standard RS-232-C is provided at pin 30 of the 36-pin, female connector used for communication with the printer. Option -005 can not receive RS-232-C data, but it does respond to control signals from an RS-232-C data set. After data is reformatted in the microcomputer, it is transferred to both the RS-232-C output and the PTI printer output. Data transfer to the RS-232-C TRANSMITTED DATA line occurs shortly before data transfer to the printer. The interface microcomputer checks the DATA SET READY, DATA CARRIER DETECTOR, and the CLEAR TO SEND line from an RS-232-C device, if one is connected. If all lines are high, the microcomputer places data on the TRANSMITTED DATA line. The data is transferred in a bit-serial format.



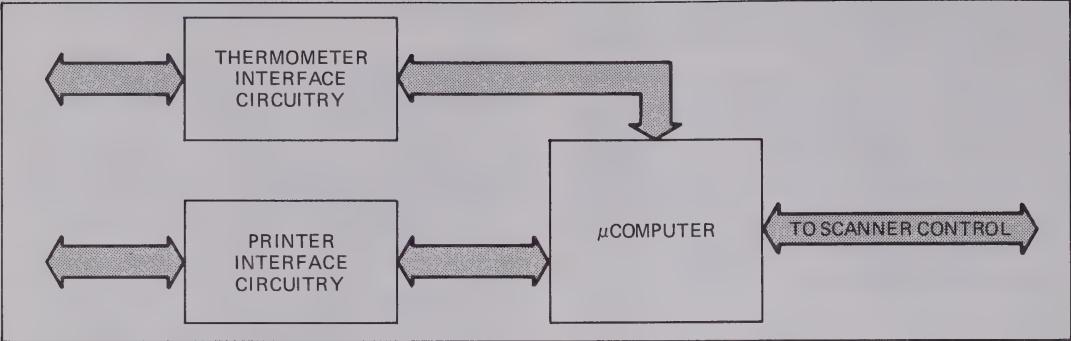


Figure 605-1. Interface (2180A/2190A) Functional Sections

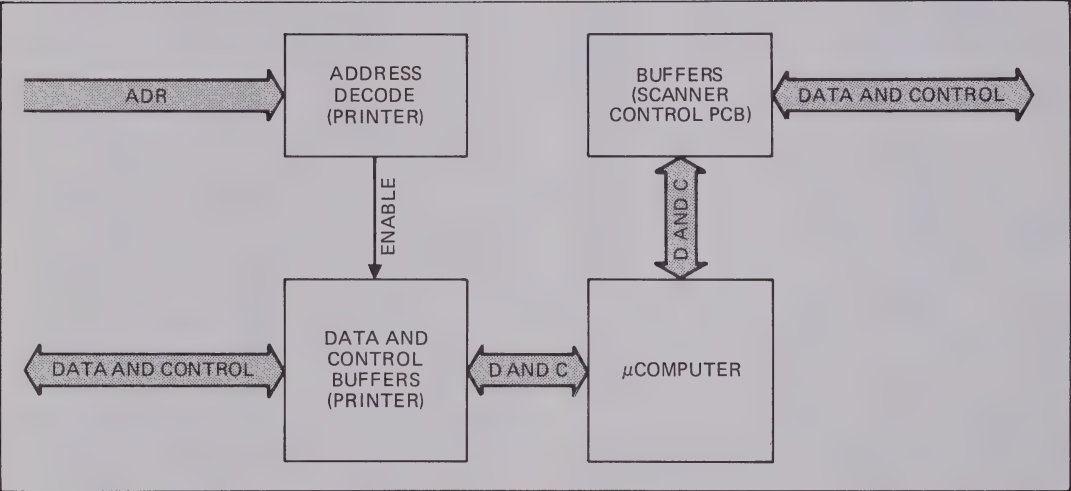


Figure 605-2. Printer Interface Block Diagram

605-23. Baud rates for RS-232-C are switch selectable on the interface pcb. A 4-segment, single-throw switch package selects any one of eight baud rates for RS-232-C data output. The first three switch-segments (1, 2, and 3) select the baud rate; segment 4 is used only for echo in receiving RS-232-C data, switch-segment 4 is not used. It may be placed in either position with no effect on the interface. The switches are connected directly to the microcomputer, and all baud rates are generated within the microcomputer. Switch positions and baud rates are listed in Table 605-4.

605-24. Connections for RS-232-C are provided on the same 36-pin, female connector used by the printer; RS-232-C connections are listed in Table 605-3.

605-25. PTI Printer Communication

605-26. Communication between the interface microcomputer and the PTI printer (Model 2020A, 2021A, or 2030A) is in ASCII format code through an

eight-line bus. With a PTI printer connected, the scanner will perform a scan only when it receives a valid address from the printer. The printer positive 5V output is routed to the interface microcomputer through a buffer, and the presents of a positive 5V level on that line informs the interface microcomputer that a printer is present. Address and control lines transfer the data in a manner that conforms to the Fluke PTI (Portable Test Instrument) standard. Refer to the block diagram in Figure 605-2.

605-27. Printer interface circuitry consists of an address decode section, data and control line buffers, the interface microcomputer, and interface-to-scanner control and data communication lines previously discussed. To initiate data transfer from the Interface (2180A/2190A) to the PTI printer, the printer outputs an address. If the address sent by the printer matches the address set through the switch in the address decode circuitry on the interface, a handshake data transfer sequence occurs.

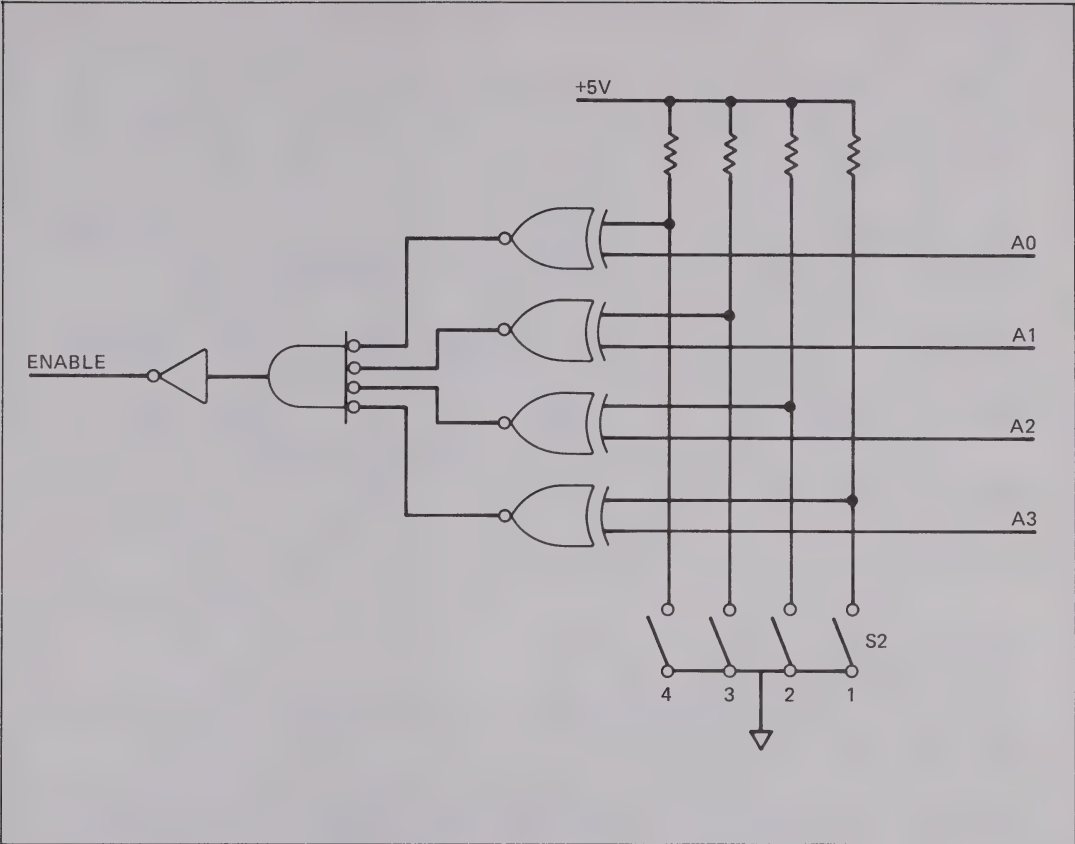


Figure 605-3. Address Decode Simplified Schematic

605-28. Address decode circuitry includes a four-segment switch and a series of gates. Refer to Figure 605-3. The printer sends a 4-bit address code to the interface; the address code may be any of the binary codes listed in Table 605-2. Every address code the printer sends on the address lines (A0 through A3) is received at the address gates on the interface. If the address sent matches the interface address established through the switch segments, all four address gates will produce a high logic output to the address AND gate. The AND gate will produce a high logic output, and the inverter at the AND gate output will pull the enable line to the buffers low. The inverter output also directly sets the Address Valid (ADRVL) line low to inform the printer that an instrument is present at that address.

605-29. Printer handshake timing is shown in Figure 605-4. With the buffers enabled and the ADRVL line set low, the interface microcomputer pulls both Data Valid (DATVL) and Scan In Progress (SCNIP) low, then places valid data on the data lines (D0 through D7). Data placed on the lines consists of one, bit-parallel ASCII

character. When the printer has read the data, it sets Data Acknowledge (DTACK) low. The interface microcomputer may then remove data and set DATVL low again to transfer the next ASCII character. The ASCII data string is terminated when the interface microcomputer sends an ASCII line feed code (hex 0A) over the data lines (D0 through D7). The line feed code is sent at the end of each scanner channel reading.

Table 605-4. RS-232-C Signals and Connector Pins

| CONNECTOR PIN | SIGNAL NAME           |
|---------------|-----------------------|
| J8-26         | Received Data         |
| J8-27         | Data Carrier Detector |
| J8-28         | Scanner Busy          |
| J8-29         | Data Terminal Ready   |
| J8-30         | Transmitted Data      |
| J8-31         | Request To Send       |
| J8-32         | Clear To Send         |
| J8-33         | Data Set Ready        |
| J8-34         | Ground                |
| J8-35         | S0+                   |
| J8-36         | S0-                   |



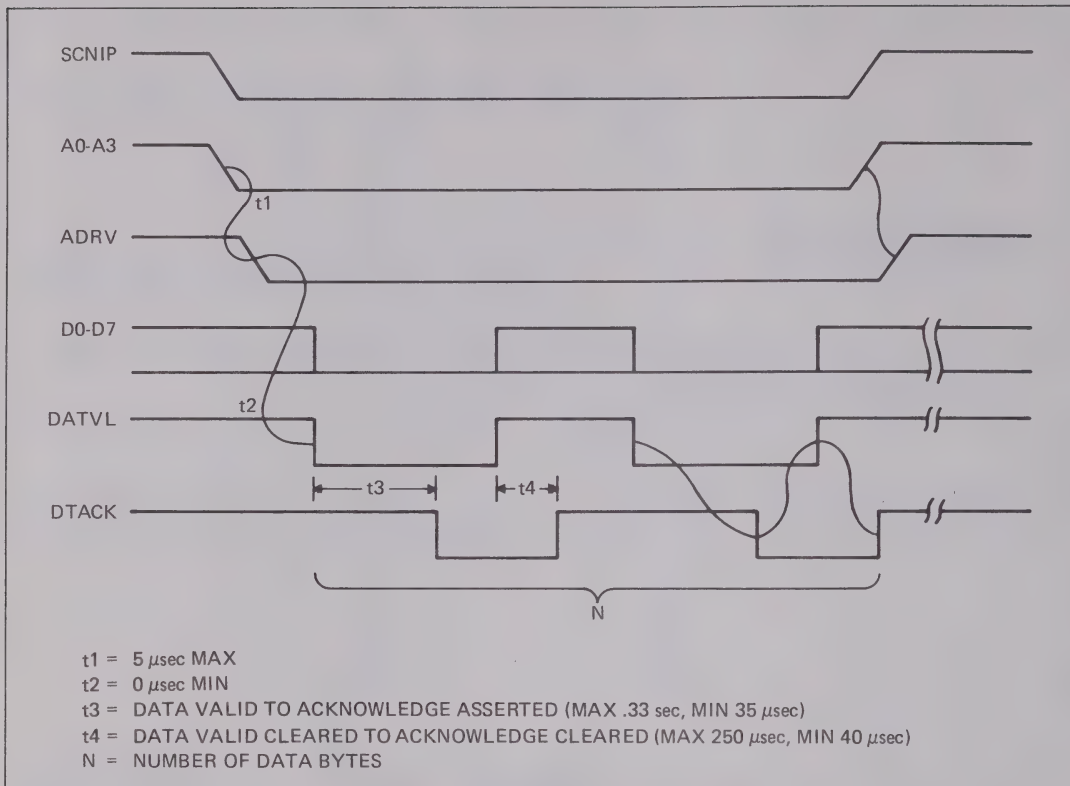


Figure 605-4. Printer Handshake Timing Diagram

605-30. Information from multiple scanner channels is transferred to the printer by holding the SCNIP line low. If the SCNIP line remains low after an ASCII line feed is received in the printer, the printer outputs the same address again. The complete handshake sequence and data transfer is repeated for each additional scanner channel as long as the SCNIP line remains low. While the last scanner channel is being read, the interface microcomputer sets the SCNIP line high. When the printer checks the SCNIP line after reading the data from the last channel, SCNIP will be high. Therefore, the printer will increment to the next highest instrument address.

#### 605-31. Thermometer Interface Circuitry

605-32. Communication between the Interface (2180A/2190A) and the connected digital thermometer is bidirectional and involves two separate bus structures. The analog bus is unidirectional and comes directly from the scanner option cards with no additional conditioning or control circuitry; the digital bus and control signals

transfer digital data and control signals between the interface microcomputer and a microcomputer in the digital thermometer. Digital data from the interface microcomputer to the thermometer consists of the thermocouple or RTD identification code and scanner channel identification information. Data transferred from the digital thermometer to the interface microcomputer is a digital interpretation of the analog data supplied by each scanner channel through the analog bus. Digital data supplied from the thermometer is reformatted in the interface microcomputer and transferred to the RS-232-C output, and the PTI printer, if one is connected.

605-33. A data transfer sequence between the thermometer and the interface is initiated when the interface microcomputer sends TRIGGER high. Refer to Figure 605-5. TRIGGER high initiates a write address (WRT ADR), digital clock (DCLK), and digital output data (DOU) output from the thermometer. All three thermometer outputs are transferred across the guard then routed to the address decode circuit. The address decode circuit supplies the proper output to the clock select gates to transfer data into and out of shift registers.

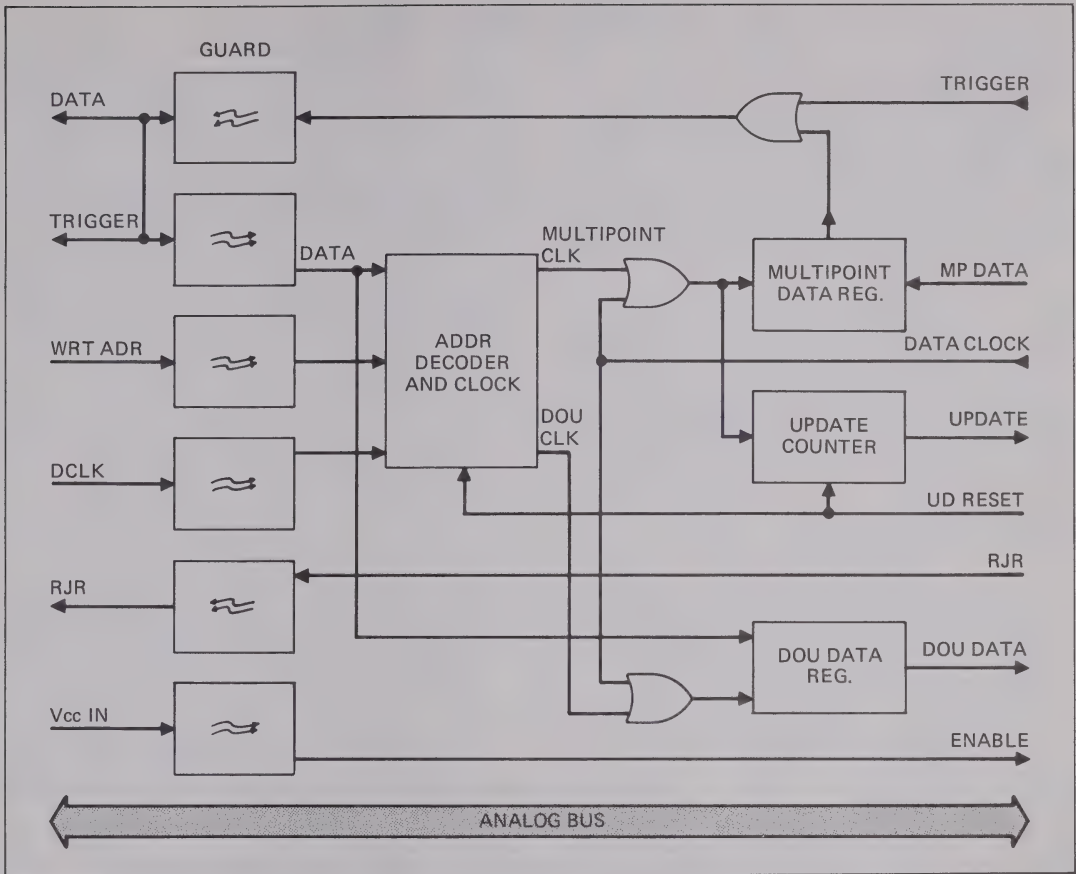


Figure 605-5. Thermometer Interface Block Diagram

605-34. Address decode circuitry consists of a series of gates and an address shift register which, together, switch clock inputs to the DOU shift register and multipoint shift register. Three signals are received in the address decode and clock select circuit: DCLK, WRT ADR, and data. The thermometer sets WRT ADR low, supplies a DCLK output, then transfers a 4-bit address over the DATA line. Data from the DATA line is accepted as an address only when the WRT ADR is low. The address transferred in on the DATA line may be any address from 0 to 6, but the interface will respond only to address 1 or address 0. If the address is 1, the clock select gates switch DCLK through an additional gate to the DOU shift register; if the address is 0, the clock select gates switch DCLK through an additional gate to the multipoint shift register.

605-35. Assuming that the thermometer has sent an address of 1, it then removes the WRT ADR low logic level, and sends serial data over the DATA line. The data is clocked into the DOU register by the DCLK and DATA CLOCK signals, because the address decode and

clock select circuit is supplying the DCLK to the DOU register as a result of the address 1. When data transfer to the DOU register is complete, the thermometer again pulls WRT ADR low. A new address, address 0, is transferred through the DATA line and into the address decode and clock select circuit. Address 0 results in the DCLK being supplied to the multipoint shift register. Data stored in the multipoint register is shifted out, across the guard circuit, to the thermometer after the WRT ADR returns high. Update counter circuitry counts the number of clock pulses at the multipoint shift register while the thermometer is reading that information. At the count of 16 (multipoint data has been read) the update counter sends an UPDATE signal to the interface microcomputer. The microcomputer then issues an UPDATE RESET pulse. The UPDATE RESET signal resets the address decode circuit and the update counter circuit. Data is then output from the microcomputer to refill the multipoint shift register, and the microcomputer reads the DOU shift register. Clock pulses to both shift registers during the multipoint refill/DOU read function

are supplied by the microcomputer on the DATA CLOCK line.

605-36. A counter circuit, the update counter, counts the clock pulses received by the multipoint shift register. It issues an UPDATE signal to the interface microcomputer after 16 clock pulses, informing the microcomputer that the multipoint shift register has been read. The microcomputer then refills, or updates, the multipoint shift register and issues an UPDATE RESET to the update counter.

605-37. Two additional isolator circuits within the guard area transfer the Reference Junction Read (RJR) signal and Vcc. The RJR signal directs the thermometer to read and update the reference junction information from the analog bus. The Vcc line supplies an enable signal to the relays, and is bussed through the interface to the Scanner Mainframe scanner control pcb after crossing the guard.

605-38. MAINTENANCE

WARNING

THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN THE OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

605-39. Introduction

605-40. This section provides service, maintenance, performance test, and calibration adjustment information. Table 605-5 lists the required test equipment. If the equipment listed is not available, test equipment with comparable specifications may be substituted.

605-41. Service Information

605-42. General service information, cleaning instructions, and warranty information contained in Section 4 of the Model 2300A Scanner Mainframe manual is applicable to the Interface (2180A/2190A) Option Card.

Table 605-5. Recommended Test Equipment

| EQUIPMENT TYPE     | RECOMMENDED MODEL           |
|--------------------|-----------------------------|
| Scanner Mainframe  | Fluke Model 2300A           |
| Scanner Option PCB | Fluke Model 2300A-002, -003 |
| Input Device       | Thermocouple or RTD         |
| Cable Accessories  | Fluke Model Y7203, Y7204    |
| Test Instrument    | Fluke Model 2180A, 2190A    |
| DMM                | Fluke Model 8000A           |
| Oscilloscope       | Tektronics 7603             |

605-43. Performance Test

605-44. The Interface option card performance test is performed with the interface card installed in a Model 2300A Scanner Mainframe. A digital thermometer (Model 2180A or 2190A) and a printer (Model 2020A, 2021A, or 2030A) must be connected to the Scanner Mainframe as described in the Scanner Mainframe installation procedures. Either a Thermocouple Scanner Card or an RTD Scanner Card must also be installed in the Scanner Mainframe, and the appropriate probe type must be connected to the scanner card inputs (refer to the applicable scanner option card installation instructions). Use the following procedure to perform test the Interface (2180A/2190A):

1. Install the interface option and the scanner card option in the 2300A Scanner Mainframe.
2. Connect the digital thermometer and printer.
3. Switch power on to all units.
4. Manually scan all connected channels. The digital thermometer should display the correct value, and the printer should print the value displayed.
5. If the digital thermometer does not display the correct values, or if the printer does not print the correct values refer to the Interface (2180A/2190A) troubleshooting table.

605-45. Calibration Adjustment

605-46. The Interface (2180A/2190A) does not require calibration adjustment, either periodically or after repair.

605-47. Troubleshooting

605-48. Troubleshooting procedures detailed in Table 605-6 should be performed only after isolating a possible malfunction to the Interface option card. The table is designed to assist in isolating a malfunction to the component level. It is arranged as a tabular flow chart; when a step in the table is complete, check for a decision transfer. If no decision is required, perform the next step in the table in sequence.

605-49. LIST OF REPLACEABLE PARTS

605-50. Table 605-7 contains an illustrated parts breakdown of the Interface (2180A/2190A). Components are listed by reference designator; each component listed is shown in an accompanying illustration. Parts ordering information is available in Section 5 of the Scanner Mainframe manual.

Table 605-6. Troubleshooting Guide

| STEP<br>NO. | ACTION                                                                                          | Go to the step<br>number given<br>for correct<br>response |    |
|-------------|-------------------------------------------------------------------------------------------------|-----------------------------------------------------------|----|
|             |                                                                                                 | YES                                                       | NO |
| 1.          | Install the interface card in a known-good Scanner Mainframe.                                   |                                                           |    |
| 2.          | Connect a known-good digital thermometer and a known-good printer to the Scanner Mainframe.     |                                                           |    |
| 3.          | Switch POWER ON to all instruments.                                                             |                                                           |    |
| 4.          | Does the thermometer display accurate information?                                              | 13                                                        | 5  |
| 5.          | Is valid data transferred across the guard circuit?                                             | 7                                                         | 6  |
| 6.          | Check the isolator circuits within the guard circuit.                                           |                                                           |    |
| 7.          | Does the address decode and clock select circuit switch both clocks to the shift register?      | 9                                                         | 8  |
| 8.          | Check the address register and clock select gates.                                              |                                                           |    |
| 9.          | Is data from the thermometer shifted into and out of the DOU shift register?                    | 11                                                        | 10 |
| 10.         | Check the DOU shift register.                                                                   |                                                           |    |
| 11.         | Is data from the interface microcomputer shifted into and out of the multipoint shift register? | 13                                                        | 12 |
| 12.         | Check the multipoint shift register and the interface microcomputer.                            |                                                           |    |
| 13.         | Does the printer produce an output identical to the thermometer indication?                     | 20                                                        | 14 |
| 14.         | Are the printer address switches set to the proper printer address?                             | 16                                                        | 15 |
| 15.         | Set the proper printer address.                                                                 |                                                           |    |
| 16.         | Are the printer address gates and data line buffers functioning?                                | 18                                                        | 17 |
| 17.         | Repair or replace the defective component.                                                      |                                                           |    |
| 18.         | Does the microcomputer receive data from the Scanner Control pcb?                               | 20                                                        | 19 |
| 19.         | Check the scanner control buffers.                                                              |                                                           |    |
| 20.         | Troubleshooting is complete. Disconnect all test equipment.                                     |                                                           |    |



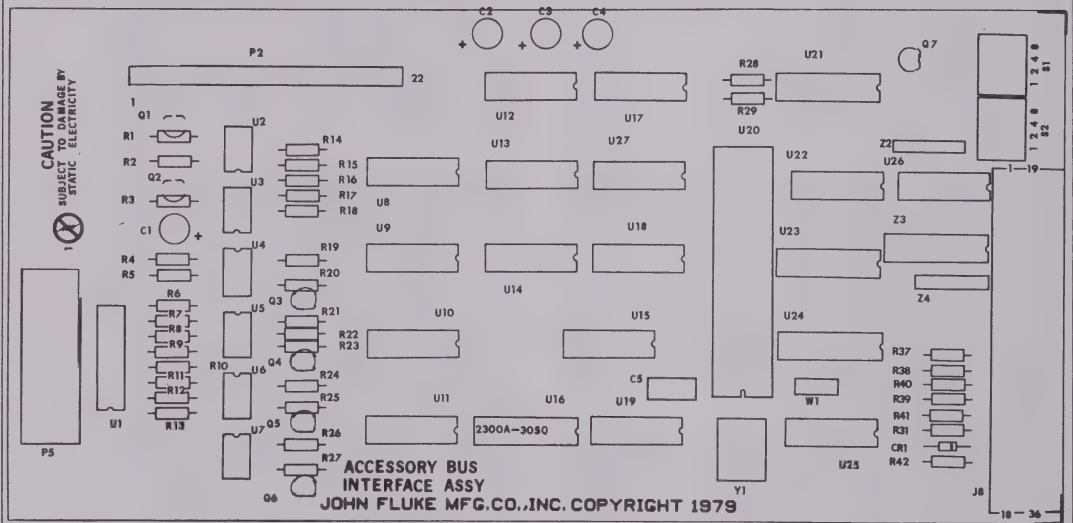
Table 605-7. Accessory Bus Interface PCB Assembly

| REF<br>DES | DESCRIPTION                                                        | FLUKE<br>STOCK<br>NO. | MFG<br>SPLY<br>CODE | MFG PART NO.<br>OR TYPE     | TOT<br>QTY | REC<br>QTY | NO<br>TE |
|------------|--------------------------------------------------------------------|-----------------------|---------------------|-----------------------------|------------|------------|----------|
| -005       | ⊗ACCESSORY BUS INTERFACE PCB ASSEMBLY<br>FIGURE 605-6 (2300A-4050) | 2300A<br>SEE          | ORDER<br>BELOW      | OPTION -005<br>FOOTNOTE "A" |            |            |          |
| C1         | CAP, TA, 10 UF +/-20%, 20V                                         | 330662                | 56289               | 196D106X0020KA1             | 4          |            | 1        |
| C2         | CAP, TA, 10 UF +/-20%, 20V                                         | 330662                | 56289               | 196D106X0020KA1             | REF        |            |          |
| C3         | CAP, TA, 10 UF +/-20%, 20V                                         | 330662                | 56289               | 196D106X0020KA1             | REF        |            |          |
| C4         | CAP, TA, 10 UF +/-20%, 20V                                         | 330662                | 56289               | 196D106X0020KA1             | REF        |            |          |
| C5         | CAP, CER, 0.22 UF +/-20%, 50V                                      | 309849                | 71590               | CW30C224K                   | 1          |            |          |
| CR1        | DIODE, SI, HI-SPEED SWITCHING                                      | 203323                | 07910               | 1N4448                      | 1          |            | 1        |
| H1         | SCREW, PHP, 2-56 X 1/2                                             | 114587                | 73734               | 19006                       | 2          |            |          |
| J8         | CONNECTOR                                                          | 518852                | 00779               | 552742-1                    | 1          |            |          |
| MP1        | CABLE ASSEMBLY                                                     | 521153                | 89536               | 521153                      | 1          |            |          |
| MP2        | CABLE CLAMP                                                        | 531236                | 89536               | 531236                      | 1          |            |          |
| Q1         | XSTR, SI, NPN                                                      | 218396                | 04713               | 2N3904                      | 6          |            | 2        |
| Q2         | XSTR, SI, NPN                                                      | 218396                | 04713               | 2N3904                      | REF        |            |          |
| Q3         | XSTR, SI, NPN                                                      | 218396                | 04713               | 2N3904                      | REF        |            |          |
| Q4         | XSTR, SI, NPN                                                      | 218396                | 04713               | 2N3904                      | REF        |            |          |
| Q5         | XSTR, SI, NPN                                                      | 218396                | 04713               | 2N3904                      | REF        |            |          |
| Q6         | XSTR, SI, NPN                                                      | 218396                | 04713               | 2N3904                      | REF        |            |          |
| Q7         | XSTR, SI, PNP                                                      | 195974                | 04713               | 2N3906                      | 1          |            |          |
| R1         | RES, DEP. CAR, 2.2K +/-5%, 1/4W                                    | 343400                | 80031               | CR251-4-5P2K2               | 6          |            |          |
| R2         | RES, DEP. CAR, 220K +/-5%, 1/4W                                    | 348953                | 80031               | CR251-4-5P220K              | 6          |            |          |
| R3         | RES, DEP. CAR, 2.2K +/-5%, 1/4W                                    | 343400                | 80031               | CR251-4-5P2K2               | REF        |            |          |
| R4         | RES, DEP. CAR, 220K +/-5%, 1/4W                                    | 348953                | 80031               | CR251-4-5P220K              | REF        |            |          |
| R5         | RES, DEP. CAR, 200 +/-5%, 1/4W                                     | 441451                | 80031               | CR251-4-5P200E              | 1          |            |          |
| R6         | RES, DEP. CAR, 10K +/-5%, 1/4W                                     | 348839                | 80031               | CR251-4-3P10K               | 4          |            |          |
| R7         | RES, DEP. CAR, 100K +/-5%, 1/4W                                    | 348920                | 80031               | CR251-4-5P100K              | 7          |            |          |
| R8         | RES, DEP. CAR, 47 +/-5%, 1/4W                                      | 441592                | 80031               | CR251-4-5P47E               | 5          |            |          |
| R9         | RES, DEP. CAR, 10K +/-5%, 1/4W                                     | 348839                | 80031               | CR251-4-3P10K               | REF        |            |          |
| R10        | RES, DEP. CAR, 100K +/-5%, 1/4W                                    | 348920                | 80031               | CR251-4-5P100K              | REF        |            |          |
| R11        | RES, DEP. CAR, 10K +/-5%, 1/4W                                     | 348839                | 80031               | CR251-4-3P10K               | REF        |            |          |
| R12        | RES, DEP. CAR, 47 +/-5%, 1/4W                                      | 441592                | 80031               | CR251-4-5P47E               | REF        |            |          |
| R13        | RES, DEP. CAR, 47 +/-5%, 1/4W                                      | 441592                | 80031               | CR251-4-5P47E               | REF        |            |          |
| R14        | RES, DEP. CAR, 47 +/-5%, 1/4W                                      | 441592                | 80031               | CR251-4-5P47E               | REF        |            |          |
| R15        | RES, DEP. CAR, 100K +/-5%, 1/4W                                    | 348920                | 80031               | CR251-4-5P100K              | REF        |            |          |
| R16        | RES, DEP. CAR, 100K +/-5%, 1/4W                                    | 348920                | 80031               | CR251-4-5P100K              | REF        |            |          |
| R17        | RES, DEP. CAR, 100K +/-5%, 1/4W                                    | 348920                | 80031               | CR251-4-5P100K              | REF        |            |          |
| R18        | RES, DEP. CAR, 47 +/-5%, 1/4W                                      | 441592                | 80031               | CR251-4-5P47E               | REF        |            |          |
| R19        | RES, DEP. CAR, 220K +/-5%, 1/4W                                    | 348953                | 80031               | CR251-4-5P220K              | REF        |            |          |
| R20        | RES, DEP. CAR, 2.2K +/-5%, 1/4W                                    | 343400                | 80031               | CR251-4-5P2K2               | REF        |            |          |
| R21        | RES, DEP. CAR, 220K +/-5%, 1/4W                                    | 348953                | 80031               | CR251-4-5P220K              | REF        |            |          |
| R22        | RES, DEP. CAR, 100K +/-5%, 1/4W                                    | 348920                | 80031               | CR251-4-5P100K              | REF        |            |          |
| R23        | RES, DEP. CAR, 2.2K +/-5%, 1/4W                                    | 343400                | 80031               | CR251-4-5P2K2               | REF        |            |          |
| R24        | RES, DEP. CAR, 220K +/-5%, 1/4W                                    | 348953                | 80031               | CR251-4-5P220K              | REF        |            |          |
| R25        | RES, DEP. CAR, 2.2K +/-5%, 1/4W                                    | 343400                | 80031               | CR251-4-5P2K2               | REF        |            |          |
| R26        | RES, DEP. CAR, 220K +/-5%, 1/4W                                    | 348953                | 80031               | CR251-4-5P220K              | REF        |            |          |
| R27        | RES, DEP. CAR, 2.2K +/-5%, 1/4W                                    | 343400                | 80031               | CR251-4-5P2K2               | REF        |            |          |
| R28        | RES, DEP. CAR, 100K +/-5%, 1/4W                                    | 348920                | 80031               | CR251-4-5P100K              | REF        |            |          |
| R29        | RES, DEP. CAR, 10K +/-5%, 1/4W                                     | 348839                | 80031               | CR251-4-3P10K               | REF        |            |          |
| R30        | RES, DEP. CAR, 51K +/-5%, 1/4W                                     | 376434                | 80031               | CR251-4-5P51K               | 4          |            |          |



Table 605-7. Accessory Bus Interface PCB Assembly (cont)

| REF<br>DES | DESCRIPTION                                                                                                                                                                           | FLUKE<br>STOCK<br>NO. | MFG<br>SPLY<br>CODE | MFG PART NO.<br>OR TYPE | TOT<br>QTY | REC<br>QTY | N<br>O<br>T<br>E |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------------|-------------------------|------------|------------|------------------|
| R31        | RES, DEP. CAR, 240 +/-5%, 1/4W                                                                                                                                                        | 376624                | 80031               | CR251-4-5P240E          | 1          |            |                  |
| R32        | RES, DEP. CAR, 51K +/-5%, 1/4W                                                                                                                                                        | 376434                | 80031               | CR251-4-5P51K           | REF        |            |                  |
| R33        | RES, DEP. CAR, 470K +/-5%, 1/4W                                                                                                                                                       | 342634                | 80031               | CR251-4-5P470K          | 2          |            |                  |
| R34        | RES, DEP. CAR, 51K +/-5%, 1/4W                                                                                                                                                        | 376434                | 80031               | CR251-4-5P51K           | REF        |            |                  |
| R35        | RES, DEP. CAR, 51K +/-5%, 1/4W                                                                                                                                                        | 376434                | 80031               | CR251-4-5P51K           | REF        |            |                  |
| R36        | RES, DEP. CAR, 470K +/-5%, 1/4W                                                                                                                                                       | 342634                | 80031               | CR251-4-5P470K          | REF        |            |                  |
| R37        | RES, DEP. CAR, 4.7K +/-5%, 1/4W                                                                                                                                                       | 348821                | 80031               | CR251-4-5P4K7           | 2          |            |                  |
| R38        | RES, DEP. CAR, 4.7K +/-5%, 1/4W                                                                                                                                                       | 348821                | 80031               | CR251-4-5P4K7           | REF        |            |                  |
| R39        | RES, DEP. CAR, 5.1K +/-5%, 1/4W                                                                                                                                                       | 368712                | 80031               | CR251-4-5P5K1           | 3          |            |                  |
| R40        | RES, DEP. CAR, 5.1K +/-5%, 1/4W                                                                                                                                                       | 368712                | 80031               | CR251-4-5P5K1           | REF        |            |                  |
| R41        | RES, DEP. CAR, 5.1K +/-5%, 1/4W                                                                                                                                                       | 368712                | 80031               | CR251-4-5P5K1           | REF        |            |                  |
| S1         | SWITCH ASSEMBLY, 4-SPST                                                                                                                                                               | 408559                | 00779               | 435166-2                | 2          |            |                  |
| S2         | SWITCH ASSEMBLY, 4-SPST                                                                                                                                                               | 408559                | 00779               | 435166-2                | REF        |            |                  |
| U1         | ⊗IC, C-MOS, HEX, BUFFER/INVERTER                                                                                                                                                      | 381830                | 02735               | CD4050AE                | 2          | 1          |                  |
| U2         | IC, OPTO-ISOLATOR                                                                                                                                                                     | 380014                | 01295               | TIL116                  | 6          | 2          |                  |
| U3         | IC, OPTO-ISOLATOR                                                                                                                                                                     | 380014                | 01295               | TIL116                  | REF        |            |                  |
| U4         | IC, OPTO-ISOLATOR                                                                                                                                                                     | 380014                | 01295               | TIL116                  | REF        |            |                  |
| U5         | IC, OPTO-ISOLATOR                                                                                                                                                                     | 380014                | 01295               | TIL116                  | REF        |            |                  |
| U6         | IC, OPTO-ISOLATOR                                                                                                                                                                     | 380014                | 01295               | TIL116                  | REF        |            |                  |
| U7         | IC, OPTO-ISOLATOR                                                                                                                                                                     | 380014                | 01295               | TIL116                  | REF        |            |                  |
| U8         | ⊗IC, C-MOS, HEX, INVERTER                                                                                                                                                             | 404681                | 02735               | CD4069BE                | 1          | 1          |                  |
| U9         | ⊗IC, C-MOS, QUAD, 2-INPUT AND GATE                                                                                                                                                    | 408401                | 02735               | CD4081BE                | 1          | 1          |                  |
| U10        | ⊗IC, C-MOS, 18-BIT STATIC SWIFT REG                                                                                                                                                   | 508432                | 04713               | MC14006BCP              | 3          | 1          |                  |
| U11        | ⊗IC, C-MOS, DUAL, "D" TYPE, F/F                                                                                                                                                       | 340117                | 02735               | CD4013AE                | 1          | 1          |                  |
| U12        | ⊗IC, C-MOS, QUAD, 2-INPUT NOR GATES                                                                                                                                                   | 355172                | 02735               | CD4001AE                | 1          | 1          |                  |
| U13        | ⊗IC, C-MOS, TRIPLE, 3-INPUT AND GATE                                                                                                                                                  | 408807                | 02735               | CD4073BE                | 1          | 1          |                  |
| U14        | ⊗IC, C-MOS, 18-BIT STATIC SWIFT REG                                                                                                                                                   | 508432                | 04713               | MC14006BCP              | REF        |            |                  |
| U15        | ⊗IC, C-MOS, DUAL 4-BIT STATIC SHIFT RGSTR                                                                                                                                             | 340125                | 04713               | MC14015CP               | 1          | 1          |                  |
| U16        | ⊗IC, C-MOS, HEX, BUFFER/INVERTER                                                                                                                                                      | 381830                | 02735               | CD4050AE                | REF        |            |                  |
| U17        | ⊗IC, C-MOS, HEX OPERN DRAIN BUFFERS                                                                                                                                                   | 473389                | 12040               | MM74C906N               | 1          | 1          |                  |
| U18        | ⊗IC, C-MOS, 18-BIT STATIC SWIFT REG                                                                                                                                                   | 508432                | 04713               | MC14006BCP              | REF        |            |                  |
| U19        | ⊗IC, C-MOS, DUAL 4-INPUT NOR GATES                                                                                                                                                    | 363820                | 04713               | MC14002CP               | 1          | 1          |                  |
| U21        | ⊗IC, C-MOS, HEX BUFFER/INVERTERS                                                                                                                                                      | 381848                | 04713               | MC14049CP               | 1          | 1          |                  |
| U22        | IC, OPERATIONAL AMPLIFIER, DUAL                                                                                                                                                       | 414284                | 12040               | LM1458N                 | 1          | 1          |                  |
| U23        | ⊗IC, C-MOS, TRI-STATE, HEX, NONINV BFFRS                                                                                                                                              | 407759                | 12040               | MM80C97N                | 2          | 1          |                  |
| U24        | ⊗IC, C-MOS, TRI-STATE, HEX, NONINV BFFRS                                                                                                                                              | 407759                | 12040               | MM80C97N                | REF        |            |                  |
| U25        | IC, QUAD LINE RECEIVER                                                                                                                                                                | 414045                | 12040               | LM1489                  | 1          | 1          |                  |
| U26        | ⊗IC, C-MOS, QUAD, "OR" AND "NOR" GATE                                                                                                                                                 | 508416                | 04713               | MC14077BCP              | 1          | 1          |                  |
| XU20       | SOCKET, IC, 40-PIN (TO U20)                                                                                                                                                           | 418988                | 91506               | 340-AC39D               | 1          |            |                  |
| Y1         | CRYSTAL, QUARTZ 400 MHZ                                                                                                                                                               | 474072                | 89536               | 474072                  | 1          |            |                  |
| Z2         | RESISTOR NETWORK, 100K                                                                                                                                                                | 412726                | 89536               | 412726                  | 2          |            |                  |
| Z3         | RESISTOR NETWORK, 10K                                                                                                                                                                 | 500710                | 89536               | 500710                  | 1          |            |                  |
| Z4         | RESISTOR NETWORK, 100K                                                                                                                                                                | 412726                | 89536               | 412726                  | REF        |            |                  |
|            | -005 OPTION CABLE <sup>11</sup>                                                                                                                                                       | 521153                | 89536               | 521153                  | 1          |            |                  |
|            | INSTRUCTION SHEET (-005)                                                                                                                                                              | 522110                | 89536               | 522110                  | 1          |            |                  |
| 25         |  ON THE A1 ASSEMBLY, INSTALL IN U4<br>FOR THE -005 OPTION THE FOLLOWING:<br>U4 IC, MICRO-PROCESSOR |                       |                     |                         | 1          | 1          |                  |
|            |                                                                                                                                                                                       | 508267                | 89536               | 508267                  |            |            |                  |



2300A-1650

Figure 605-6. Accessory Bus Interface PCB Assembly

## Option -006

# Remote Control Interface

### 606-1. INTRODUCTION

606-2. Interface Option -006, the Remote Control Interface (2180A/2190A) for use with Fluke digital thermometers, is a microcomputer controlled interface that allows the 2300A Scanner Mainframe to operate as a temperature scanner with either the Thermocouple Scanner Card (Option -002) or the RTD/Ohms Scanner Card (Option -003) installed in the mainframe. The interface provides an output compatible with the Fluke PTI (portable test instrument) printers (Models 2020A, 2021A, and 2030A) and bi-directional RS-232-C communication. It accepts remote control commands conforming to RS-232-C standard. Remote commands can control selection of local/remote operation, set the channel delay time, establish or clear the skip condition for an individual channel or a group of channels, monitor a single channel, or select particular channels to be printed.

606-3. With a Remote Control Interface installed in a 2300A, a temperature scanning system with remote control, RS-232-C output, and printing capability is possible. A PTI (portable test instrument) printer may be connected to the 2300A, through the interface, to provide a hard-copy output of all data. An RS-232-C data set may be connected to the scanner, through the interface, to provide remote control and data monitoring. Connecting an RS-232-C device to the interface requires use of a Model Y2026B RS-232 Cable Adaptor. With the adaptor connected, a printer and an RS-232-C data set may be connected simultaneously, but if both are connected, the printer should be used in the continuous-print mode. Operating the printer in an interval print mode may result in conflict between the printer and RS-232-C data set; both pieces of equipment supply some control to the interface.

606-4. The Remote Control Interface installs in the Scanner Mainframe, and it communicates with the

Scanner Control PCB through a 22-pin, in line connector mounted on the interface pcb. Communication with the digital thermometer is through the 25-pin, cable-mounted connector; communication with the Model 2020A or 2030A Printer is through a 36-pin, panel-mounted connector, and RS-232-C communication takes place through the same connector. The cable-mounted thermometer connector extends from the Scanner Mainframe rear panel just above the printer/RS-232-C connector when Option -006 is installed in the Scanner Mainframe.

### 606-5. SPECIFICATIONS

606-6. The Remote Control Interface meets all environmental specifications given for the Model 2300A Scanner Mainframe. Additional specifications applicable to the Remote Control Interface are listed in Table 606-1.

### 606-7. INSTALLATION

606-8. Option -006, the Remote Control Interface, is factory installable only in the 2300A Scanner Mainframe. It cannot be installed in the 2301A Scanner Extender. Installation procedures given for the 2300A Scanner Mainframe are valid with Option -006 installed in the 2300A Scanner.

606-9. Remote control operation requires installation connections in addition to those given for the 2300A Scanner Mainframe. To connect the 2300A to an RS-232-C control device, first disconnect the PTI printer if one is in use. Connect the 2300A DATA I/O CONNECTOR to a Fluke Model Y2026B RS-232-C Cable Adaptor (J3) using cable accessory Y7203 (2 ft.) or Y7204 (5 ft.). Using a standard RS-232-C cable with 25-pin connectors, connect either the male or female 25-pin connector on the Y2026B to the RS-232-C control device. If printing capability is required, connect a PTI (portable test instrument) printer to J4, one of the 36-pin connectors on

the Y2026B, using either the Y7203 or Y7204 cable accessory. Switches mounted on the Y2026B allow selection of certain RS-232-C pin assignments (refer to the Y2026B Instruction Sheet).

NOTE

*A Model 2020A Printer with interface Option -001 is the recommended printer for use with a remote control device connected to the interface. A Model 2020A with interface Option -004 or a 2030A Printer may be used, but, since both the printer and the RS-232-C data set supply some scanner control, a control conflict may develop that would hang-up the system. Any printer should be used only in Continuous Print mode if a controlling device is in use. If no controller is in use, any PTI printer (2020A-001, 2020A-004, or 2030A) may be used in any print mode.*

Table 606-1. Specifications

|                                                                                                          |  |
|----------------------------------------------------------------------------------------------------------|--|
| <b>INTERFACE COMPATIBILITY:</b>                                                                          |  |
| 2300A to: 2180A, 2190A, 2020A-001, 2020A-004, 2021A-001, 2021A-004, 2030A, Y2026B, and RS-232-C devices. |  |
| <b>THERMOMETER OUTPUT:</b> Optically Isolated                                                            |  |
| <b>PRINTER OUTPUT:</b>                                                                                   |  |
| PTI standard bit-parallel, character-serial ASCII.<br>(addresses 1, 6, 7, 8, and 9 are valid)            |  |
| <b>THERMOMETER CONNECTOR:</b>                                                                            |  |
| Cable-mounted, 25-pin male                                                                               |  |
| <b>PRINTER/RS-232-C CONNECTOR</b>                                                                        |  |
| Board-mounted, 36-pin female                                                                             |  |
| <b>RS-232-C BAUD RATES:</b>                                                                              |  |
| Switch selectable: 110, 150, 300, 600, 1200, 2400, 4800, and 9600. (2400-9600 output only).              |  |
| <b>RS-232-C I/O:</b>                                                                                     |  |
| Bi-directional: Remote control and data monitoring.                                                      |  |
| <b>CURRENT LOOP:</b>                                                                                     |  |
| 20 mA, output only                                                                                       |  |
| <b>REMOTE COMMANDS:</b>                                                                                  |  |
| All 2300A front panel selectable functions                                                               |  |

606-10. OPERATING NOTES

606-11. Address and Baud Rate Selection

606-12. Model 2300A Scanner Mainframe operating instructions are valid, in local operating mode, for a 2300A Scanner Mainframe with the Remote Control Interface installed. If remote operation through an RS-232-C control device is required, refer to the remote control operating procedures given in this section.

606-13. Two switches on the interface pcb allow the operator to select a PTI address for printer output and the appropriate baud rate for RS-232-C communication. A printer connected to the interface will send up to nine preset addresses in order to receive information from nine possible source instruments, including the 2300A Scanner Mainframe. The address from the printer to which the interface will respond must be selected by the operator through switch S2. The interface will respond to any of the nine valid printer addresses, but the printer can produce intelligible output only if one of the addresses that specifies transfer of ASCII data using the handshake transfer mode is selected. Table 606-2 lists the valid printer addresses and the corresponding switch codes.

606-14. A Model 2020A or 2021A printer using the parallel ASCII printer interface (printer Option -001) requires printer address number one to be set through switch S2. The parallel ASCII interface can send only printer address number one. If a 2020A or 2021A Printer is connected using the PTI printer interface (printer option -004), or if a Model 2030A Printer is in use, then addresses 1, 6, 7, 8, and 9 are valid for use on the Remote Control Interface in the 2300A Scanner Mainframe. Refer to Table 606-2 for a list of switch positions and codes for each valid address.

606-15. Eight different baud rates are also switch-selectable on the Remote Control Interface. Refer to Table 606-3 for a list of switch positions and corresponding baud rates.

Table 606-2. Printer Addresses

| SWITCH                                                                                                                  |     |     |     | ADR.<br>NO. | DATA TYPE/<br>TRANSFER MODE |
|-------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-------------|-----------------------------|
| 1                                                                                                                       | 2   | 4   | 8   |             |                             |
| OFF                                                                                                                     | OFF | OFF | OFF | 0           | -----                       |
| OFF                                                                                                                     | OFF | OFF | ON  | 1           | Parallel ASCII/Handshake    |
| OFF                                                                                                                     | OFF | ON  | OFF | 2           | BCD/Clocked                 |
| OFF                                                                                                                     | OFF | ON  | ON  | 3           | BCD/Clocked                 |
| OFF                                                                                                                     | ON  | OFF | OFF | 4           | BCD/Clocked                 |
| OFF                                                                                                                     | ON  | OFF | ON  | 5           | BCD/Clocked                 |
| OFF                                                                                                                     | ON  | ON  | OFF | 6           | Parallel ASCII/Handshake    |
| OFF                                                                                                                     | ON  | ON  | ON  | 7           | Parallel ASCII/Handshake    |
| ON                                                                                                                      | OFF | OFF | OFF | 8           | Parallel ASCII/Handshake    |
| ON                                                                                                                      | OFF | OFF | ON  | 9           | Parallel ASCII/Handshake    |
| ON                                                                                                                      | OFF | ON  | OFF | F           | None                        |
| <b>NOTE:</b><br>Only those addresses which transfer ASCII data in a handshake mode are valid for Options -005 and -006. |     |     |     |             |                             |
|                                                                                                                         |     |     |     |             |                             |



Table 606-3. Baud Rate Selection

| BAUD RATE    | SWITCH SEGMENTS |     |     |      |
|--------------|-----------------|-----|-----|------|
|              | 1               | 2   | 4   | 8    |
| 110          | OFF             | OFF | OFF | ---- |
| 150          | ON              | OFF | OFF | ---- |
| 300          | OFF             | ON  | OFF | ---- |
| 600          | ON              | ON  | OFF | ---- |
| 1200         | OFF             | OFF | ON  | ---- |
| *2400        | ON              | OFF | ON  | ---- |
| *4800        | OFF             | ON  | ON  | ---- |
| *9600        | ON              | ON  | ON  | ---- |
| *Output Only |                 |     |     |      |

*NOTE*  
 Segment 8 may be in either position:  
 ON = ECHO: OFF = NO ECHO

606-16. The following procedure may be used to change the PTI address or the RS-232-C baud rate:

1. Switch 2300A Scanner Mainframe power off.
2. Disconnect all power to the scanner.

3. Pull out the black release buttons on the scanner option cards.

4. Remove the scanner option cards.

5. Both switches (S1 and S2) are located at the rear of the interface pcb, to the right of the rear-panel connector. (Refer to Figure 606-1).

6. Select the desired code for each switch.

7. Re-install the scanner option cards.

8. Reconnect all cables, then refer to the 2300A Scanner operating procedure, or the RS-232-C Remote Operating Procedure.

### 606-17. RS-232-C Command Formats and Error Messages

606-18. Remote control through the Remote Control Interface requires that specific characters be transferred from the RS-232-C controlling device to the interface to control specific scanner functions. In addition, the interface generates certain error messages and transfers them to the controlling device if the wrong command characters are entered. All characters are in ASCII code, and are transferred serially as required by the RS-232-C standard.

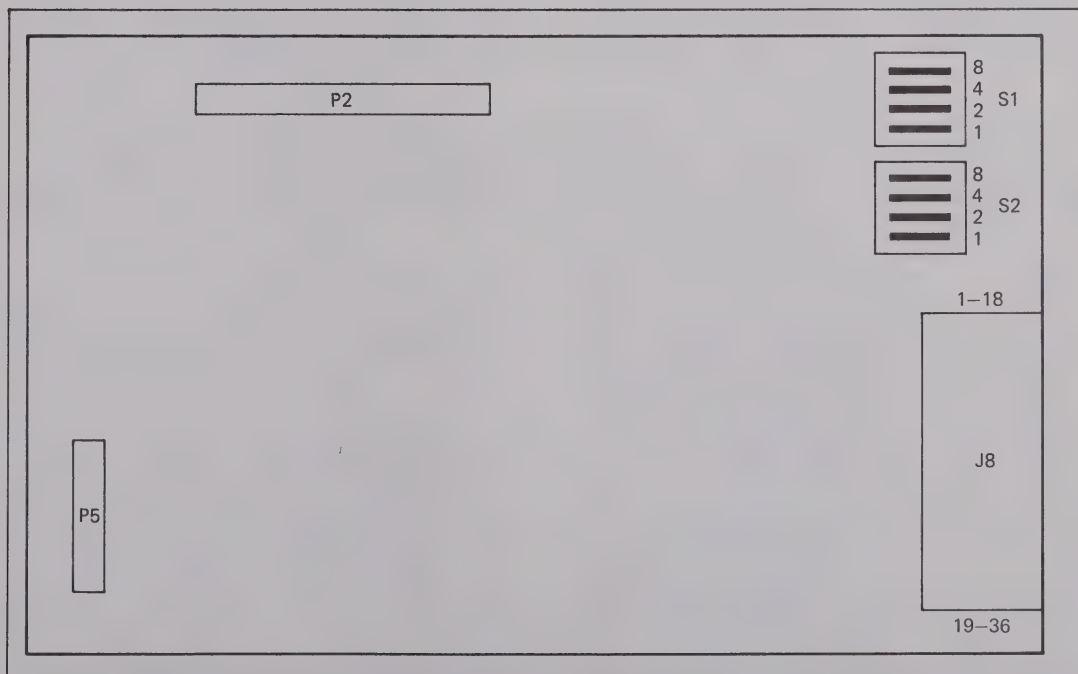


Figure 606-1. Switch and Connector Locations

606-19. An Escape character (hex "1B") is required to switch the interface from a command mode to a monitor mode. Assuming the system is in the command mode, the operator can enter a command character string. When the Remote Control Interface has accepted the command, it sends a carriage return, then a line feed code to inform the controller that the command has been accepted. The scanner will execute the command immediately, but no data is sent to the controller until the operator enters an Escape character. The Escape character places the interface in an output mode, so it can supply data for the controller to monitor. If the controller is in the monitor mode, an Escape character must be entered to place the interface in a command mode. The Escape character, in effect, toggles the interface between command and monitor modes. If the interface is in the command mode, it sends a question mark (?) to the controller, indicating that it is awaiting a command. If the interface is in the monitor mode, it sends data to the controller.

606-20. Command characters select either remote or local scanner operation, establish or alter the channel delay time, select one or a group of channels to be skipped or enabled, monitor a single channel, and select single-scan or continuous, automatic-scan operation. All remotely controllable scanner functions are also selectable through front-panel, operator controls. In response to requests from the controlling device, the interface may send the current scan mode, current channel number, first and last channel numbers, or the selected delay time to the controlling device. Remote

Control Interface command characters are listed in Table 606-4.

606-21. When the RS-232-C controlling device is in the command mode, a carriage return and line feed code from the interface informs the controlling device that the command has been accepted. After the command is accepted, the scanner will perform the operation requested, but no data will be transferred to the controlling device until an Escape character is entered. An Escape character toggles the system between the command mode and the monitor mode.

606-22. If the interface receives a character string that it doesn't recognize, or can't respond to, it sends an error message to the controlling device. Three error messages are possible: SYNTAX ERROR, TYPE R FIRST, and nn NOT THERE (nn = a channel number). The SYNTAX ERROR message is sent to the controlling device when the interface does not recognize a command character string. Usually, this error message indicates that the command character was not entered using the correct format. The TYPE R FIRST error message means the scanner is in local operating mode and cannot accept a remote command. The scanner can, however, respond to the information request commands (XP, RP, M MP) when in the local mode. These commands simply request data from the scanner; they don't modify scanner operation. To initiate remote operation, enter the letter R, then a carriage return. The nn NOT THERE error message occurs when a command is entered for a channel (nn) that is not present in the system.

606-4. Command Characters

| COMMAND      | RESPONSE                                                                      |
|--------------|-------------------------------------------------------------------------------|
| R            | Places Scanner in Remote Mode                                                 |
| L            | Places Scanner in Local Mode                                                  |
| D nn         | Sets Channel Delay = N.N Seconds                                              |
| D n.n        | Sets Channel Delay = N.N Seconds                                              |
| S nn         | Sets Skip on Channel nn                                                       |
| S nn-mm      | Sets Skip on Channels nn-mm                                                   |
| U nn         | Clears Skip on Channel nn                                                     |
| U nn-mm      | Clears Skip on Channel nn-mm                                                  |
| M nn         | Monitor Channel nn                                                            |
| A            | Automatic Scan                                                                |
| A nn-mm      | Automatic Scan Channels nn-mm                                                 |
| X            | Single Scan                                                                   |
| X nn-mm      | Single Scan Channels nn-mm                                                    |
| RP           | Print Scan Mode on Controller                                                 |
| MP           | Print Current Channel on Controller                                           |
| AP           | Print first and last channel number on Controller                             |
| XP           | Print first and last channel number on Controller                             |
| DP           | Print Channel Delay time on Controller                                        |
| ESC (hex 1B) | Shift from Command Mode to Monitor Mode and from Monitor Mode to Command Mode |

## 606-23. Remote Control Operation

606-24. Remote operation involves entering the required command characters, through an RS-232-C control device, to initiate the desired scanner functions. Refer to Table 606-4, the interface command characters. The command characters may be entered as part of an operating program written by the user for his specific RS-232-C device, or they may be entered manually through a keyboard attached to the control device. The following operating example assumes use of a Hazeltine 1500 as the controlling device.

1. Connect the Hazeltine 1500 to the scanner system through a Y2026B as described in the installation instructions.
2. Switch on power to all system components. (If the system is in a monitor mode, information will be displayed on the Hazeltine; if the system is in the command mode, a question mark will appear on the Hazeltine).
3. If the system is in the monitor mode, press the ESC key to shift to the command mode. (A question mark should appear on the screen).
4. Enter an "R", followed by a carriage return, to place the interface in the remote operating mode.
5. Enter a "D", followed by two digits, then a carriage return, to select a channel delay time.
6. Enter an "S", followed by two digits, then a carriage return, to set the skip condition for a single channel. Enter an "S", two digits, a dash, two more digits, then a carriage return, to set the skip condition for a block of channels.
7. Enter a "U", followed by the appropriate two digits, then a carriage return, to clear any unnecessary skip conditions. A block-skip may be cleared by entering a "U", two digits, a dash, two more digits, then a carriage return.
8. Enter an "A", followed by a carriage return, to select automatic, continuous-scan operation. Enter an "X", followed by a carriage return, to select a single scan of all connected channels. Enter an "M" followed by a carriage return to monitor the current channel, or enter an "M", then a two-digit channel number, followed by a carriage return, to monitor any selected channel.
9. Push the ESC key after selecting an operating mode. (Operating commands are executed immediately, but the scanner will not send

information to the Hazeltine 1500 until it is placed in the monitor mode by pushing the ESC key).

10. Refer to Table 606-4 for additional remote control commands.

## 606-25. THEORY OF OPERATION

### 606-26. Introduction

606-27. The theory of operation discussion consists of two parts: an overall functional description and a block diagram description of each interface functional section. Diagrams and simplified schematics are included, as necessary, to supplement the text. Option -006, the Remote Control Interface, utilizes the same hardware as Option -005, with the exception of the microcomputer on the interface pcb and the microcomputer on the Scanner Control PCB in the 2300A Scanner Mainframe. The schematic included in Section 8 of the 2300A manual for Option -005 (drawing number 2300A-1050) is also valid for Option -006. Only the programming resident in the microcomputers is different.

### 606-28. Overall Functional Description

606-29. Interface circuitry allows the 2300A Scanner Mainframe to communicate with the mainframe Scanner Control PCB, a digital thermometer, an RS-232-C device, and a PTI system printer. The interface, as shown in Figure 606-2, consists of four distinct functional sections: the thermometer interface circuitry, the printer interface circuitry, the RS-232-C interface circuitry, and the microcomputer that controls all interface functions. In addition to the components located on the interface pcb, a second microcomputer with unique programming is installed in the Scanner Control PCB within the 2300A Scanner, to replace the existing microcomputer. The microcomputer is part of Option -006, although it is located in the 2300A Scanner Mainframe.

606-30. Data and control signals from the Scanner Control PCB in the 2300A are transferred to the interface microcomputer through buffers. Printer data and handshake signals are also transferred through buffers. Address decoding circuitry is necessary, as well, to allow the interface to respond to only one printer address. Interface input and output signals to the digital thermometer are isolated through a guard circuit, and an address decoding circuit is present, also, to interpret the address from the digital thermometer. Control, address, and serial digital data to the thermometer passes through the guard circuit, but the analog data from each channel is passed straight through the interface to the thermometer. Data and control signals for RS-232-C communication are also buffered, and the control signals are gated to the microcomputer.

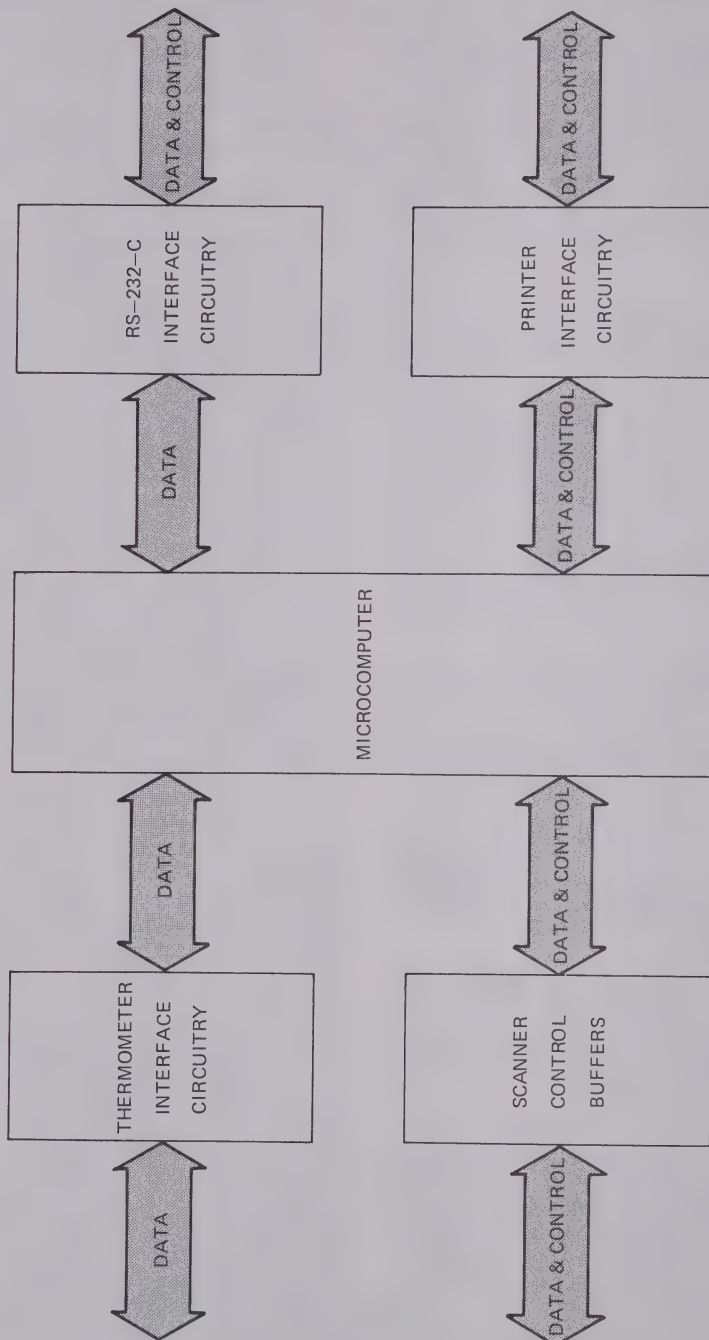


Figure 606-2. Interface Functional Sections



## 606-31. Block Diagram Analysis

### 606-32. SCANNER CONTROL COMMUNICATION

606-33. Data from the Scanner Control PCB is transferred to the interface pcb microcomputer through a buffer. Data from the interface microcomputer is transferred to the Scanner Control PCB through a buffer. Three data transfer control lines (Acknowledge, Ready, and Data Valid) are also buffered. Data is received in the interface microcomputer on the DATA FROM line (from the scanner control microcomputer). Data is transmitted to the scanner control microcomputer on the DATA TO line.

606-34. Data is transferred to the interface microcomputer from the Scanner Control PCB in a bit-serial, handshake transfer mode. The transfer sequence commences with the transfer lines in an idle, or wait state. In the wait state, the DATA TO line is at a high logic level, the DATA FROM line is low, the DVL (Data Valid) line is high, the ACK (Acknowledge) line is low, and the RDY (Ready) line is high. First, the scanner control microcomputer places valid data on the DATA FROM line. It then pulls the DVL line low to inform the interface microcomputer that valid data is available. After reading the data, the interface microcomputer sets the ACK line to a high logic level and the RDY line to a low logic level. When the ACK line goes high, the scanner control microcomputer removes data from the DATA FROM line, and returns the DVL signal to a high state. The interface microcomputer then pulls the ACK line low again, and allows the RDY line to go high.

606-35. Data transfer from an interface option to the Scanner Control PCB microcomputer is also accomplished using a handshake data transfer sequence. A data transfer is initiated by the scanner control microcomputer; it sends an 8-bit data word on the DATA FROM line. The 8-bit data word addresses the interface (or an extender) and requests it to reply. The scanner control microcomputer then goes to the listen state by placing both DVL and DATA FROM high. With the microcomputer in the listen state, the addressed interface option can transfer data to the Scanner Control PCB. After the talk command is transferred, the addressed interface (or scanner extender) will pull the DATA TO line low signifying that it is ready to reply. When the scanner control microcomputer receives a low logic level on the DATA TO line, it then pulls DVL low. Shortly after DVL is set low, all extenders, since they are not replying, read the DATA FROM line (high), and release the ACK line, allowing it to go high. As they release the ACK line, they also pull the RDY line low. The interface then places data on the DATA TO line, and releases the

ACK line, allowing it to go high. When the scanner control microcomputer sees ACK high and RDY low, it reads the DATA TO line, then sets DVL high. It also pulls DATA FROM low, indicating that it is not ready to receive an additional data bit. In response to the DVL high logic level, all unaddressed extenders release the RDY line, allowing it to go high, and pull ACK low. The responding interface then removes data from the DATA TO line and sets it high. It then releases the RDY line, allowing it to go high, and pulls ACK low, thereby re-entering the ready state. When the scanner control microcomputer is ready to receive the next data bit, it sets the DATA FROM line high and initiates another data bit handshake sequence. All data transfers are either single or multiple 8-bit data words.

### 606-36. PTI PRINTER COMMUNICATION

606-37. Communication between the interface microcomputer and the PTI printer (Model 2020A, 2021A, or 2030A) is in ASCII format code through an eight-line bus. With a PTI printer connected, the scanner performs a scan only when it receives a valid address from the printer. The printer's positive 5V output is routed to the interface microcomputer through a buffer, and the presence of a positive 5V level on that line informs the interface microcomputer that a printer is present. Address and control lines transfer the data in a manner that conforms to the Fluke PTI (portable test instrument) standard. Refer to Figure 606-3, the Printer Interface Block Diagram.

606-38. Printer interface circuitry consists of an address decode section, data and control line buffers, the interface microcomputer, and interface-to-scanner control and data communication lines previously discussed. To initiate data transfer from the Interface (2180A/2190A) to the PTI printer, the printer sends an address. If the address sent by the printer matches the address set through the switch in the address decode circuitry on the interface, a handshake data transfer sequence occurs.

606-39. Address decode circuitry includes a four-segment switch and a series of gates. Refer to Figure 606-4, the Address Decode Simplified Schematic. The printer sends a 4-bit address code to the interface; the address code may be any of the binary codes listed in Table 606-2. Every address code the printer sends on the address lines (A0 through A3) is received at the address gates on the interface. If the address sent matches the interface address established through the switch segments, all four address gates will produce a high logic output to the address AND gate. The AND gate will produce a high logic output, and the inverter at the AND gate output will pull the enable line to the buffers low. The inverter output also sets the Address Valid (ADRVL) line low to inform the printer that an instrument is present at that address.

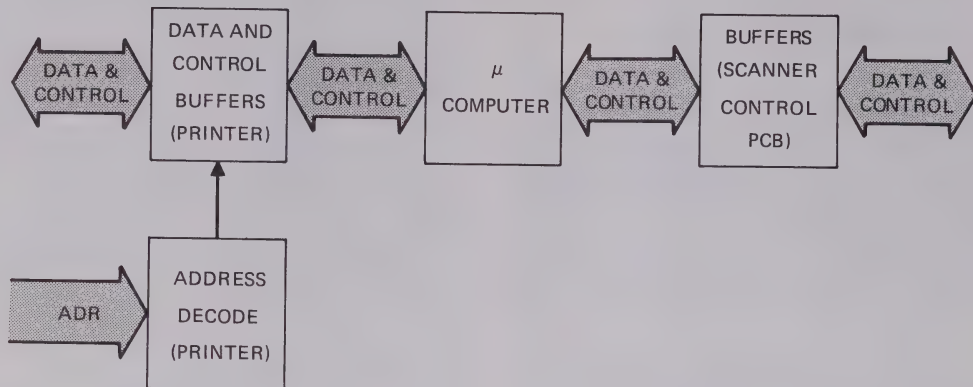


Figure 606-3. Printer Interface Block Diagram

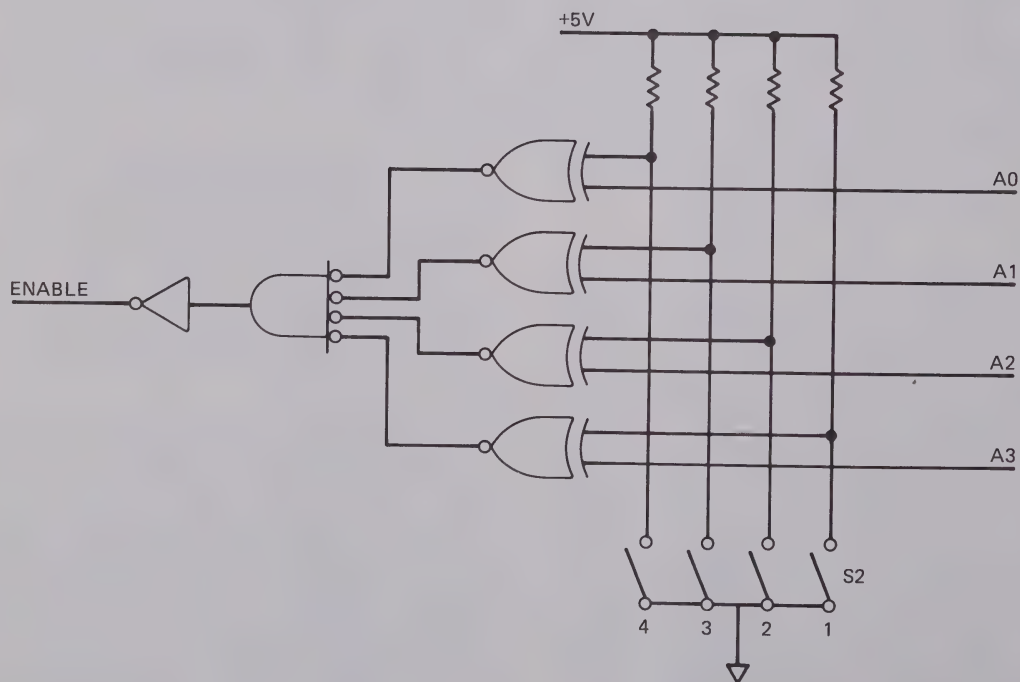


Figure 606-4. Address Decode Simplified Schematic

606-40. Refer to Figure 606-5, the Printer Handshake Timing Diagram. With the buffers enabled and the  $\overline{\text{ADRVL}}$  line set low, the interface microcomputer places valid data on the data lines (D0 through D7), then pulls both Data Valid ( $\overline{\text{DVL}}$ ) and Scan In Progress ( $\overline{\text{SCNIP}}$ ) low. Data placed on the line consists of one, bit-parallel ASCII character. When the printer has read the data, it sets Data Acknowledge ( $\overline{\text{DTACK}}$ ) low. The interface microcomputer may then set  $\overline{\text{DATVL}}$  low again to transfer the next ASCII character. The ASCII data string is terminated when the interface microcomputer sends an ASCII line feed code over the data lines (D0 through D7). The line feed code is sent at the end of each scanner channel reading.

606-41. Information from multiple scanner channels is transferred to the printer by holding the  $\overline{\text{SCNIP}}$  line low. If the  $\overline{\text{SCNIP}}$  line remains low after an ASCII line feed is received in the printer, the printer sends the same address again. The complete handshake sequence and data transfer is repeated for each additional scanner channel as long as the  $\overline{\text{SCNIP}}$  line remains low. While the last scanner channel is being read, the interface microcomputer sets the  $\overline{\text{SCNIP}}$  line high. When the printer checks the  $\overline{\text{SCNIP}}$  line after reading the data from

the last channel,  $\overline{\text{SCNIP}}$  will be high. Therefore, the printer will increment to the next highest instrument address.

#### 606-42. THERMOMETER INTERFACE CIRCUITRY

606-43. Communication between the Remote Control Interface (2180A/2190A) and the connected digital thermometer is bi-directional and involves two separate bus structures. The analog bus is uni-directional and comes directly from the scanner option cards with no additional conditioning or control circuitry. The digital bus and control lines transfer digital data and control signals between the interface microcomputer and a microcomputer in the digital thermometer. Digital data from the interface microcomputer to the thermometer consists of the thermocouple or RTD identification code and scanner channel identification information. Data transferred from the digital thermometer to the interface microcomputer is a digital interpretation of the analog data supplied by each scanner channel through the analog bus. Digital data supplied from the thermometer is reformatted in the interface microcomputer and transferred to the RS-232-C device and the PT1 printer, if one is connected.

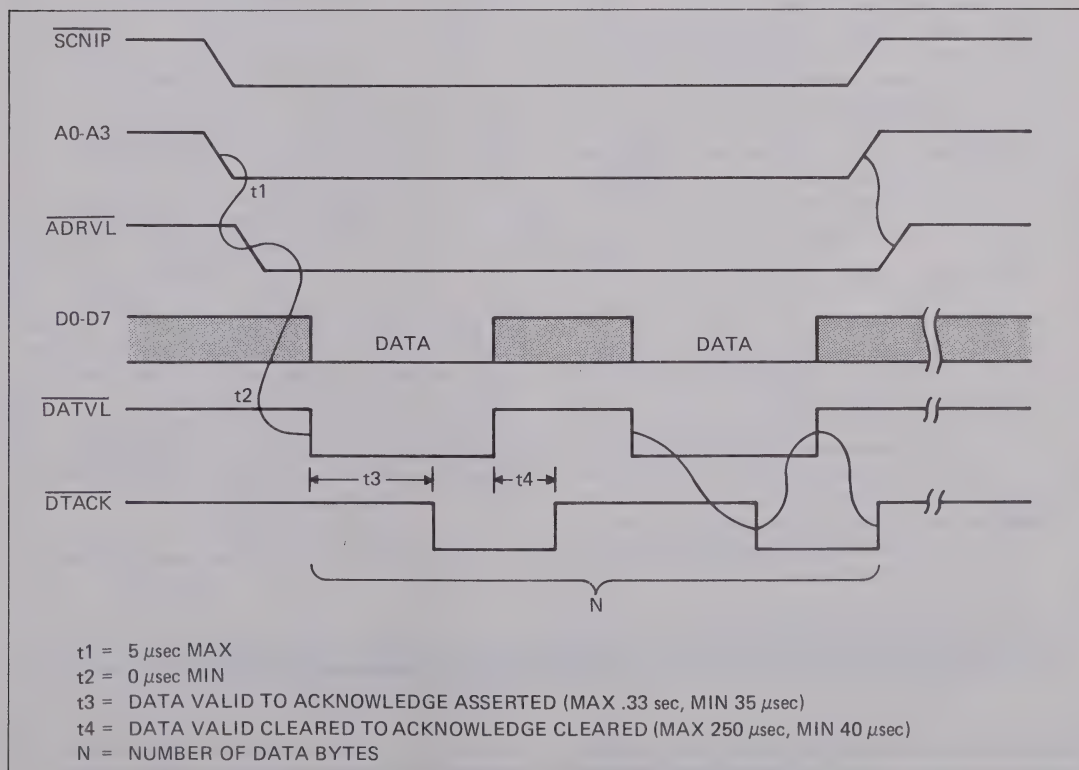


Figure 606-5. Printer Handshake Timing Diagram

606-44. A data transfer sequence between the thermometer and the interface is initiated when the interface microcomputer sends  $\overline{\text{TRIGGER}}$  high. Refer to Figure 606-6, the Thermomter Interface Block Diagram.  $\overline{\text{TRIGGER}}$  high initiates a write address ( $\overline{\text{WRT ADR}}$ ), digital clock ( $\overline{\text{DCLK}}$ ), and digital output data (DOU) output from the thermometer. All three thermometer outputs are transferred across the guard, then to the address decode circuit. The address decode circuit supplies the proper output to the clock select gates to transfer data into and out of the shift registers.

606-45. Address decode circuitry consists of a series of gates and an address shift register which, together, switch

clock inputs to the DOU shift register and the multipoint shift register. Three signals are received in the address decode and clock select circuit:  $\overline{\text{DCLK}}$ ,  $\overline{\text{WRT ADR}}$ , and data. The thermometer sets  $\overline{\text{WRT ADR}}$  low, supplies a  $\overline{\text{DCLK}}$  output, then transfers a 4-bit address over the DATA line. Data from the DATA line is accepted as an address only when  $\overline{\text{WRT ADR}}$  is low. The address transferred in on the DATA line may be any address from 0 to 6, but the interface will respond only to address 1 or address 0. If the address is 1, the clock select gates switch  $\overline{\text{DCLK}}$  through an additional gate to the DOU shift register; if the address is 0, the clock select gates switch  $\overline{\text{DCLK}}$  through an additional gate to the multipoint shift register.

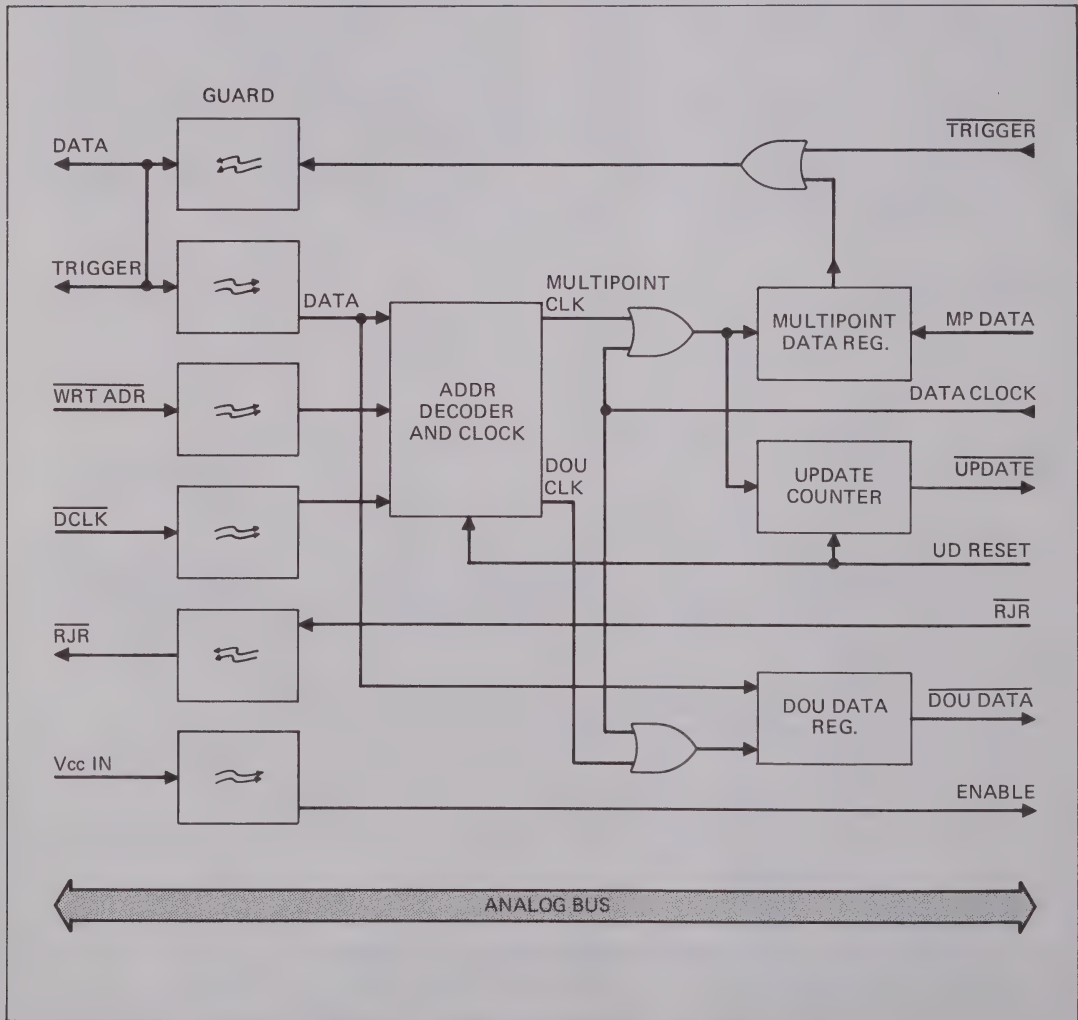


Figure 606-6. Thermometer Interface Block Diagram



606-46. Assuming that the thermometer has sent an address of 1, it then removes the WRT ADR low logic level, and sends serial data over the DATA line. The data is clocked into the DOU register by the DCLK and DATA CLOCK signals, because the address decode and clock select circuit is supplying the DCLK to the DOU register as a result of the address 1. When data transfer to the DOU register is complete, the thermometer again pulls WRT ADR low. A new address, address 0, is transferred through the DATA line and into the address decode and clock select circuit. Address 0 results in the DCLK being supplied to the multipoint shift register. Data stored in the multipoint register is shifted out, across the guard circuit, to the thermometer after the WRT ADR returns high. Update counter circuitry counts the number of clock pulses at the multipoint shift register while the thermometer is reading that information. At the count of 16 (multipoint data has been read) the update counter sends an UPDATE signal to the interface microcomputer. The microcomputer then issues an UPDATE RESET pulse. The UPDATE RESET signal resets the address decode circuit and the update counter circuit. Data is then output from the microcomputer to refill the multipoint shift register, and the microcomputer reads the DOU shift register. Clock pulses to both shift registers during the multipoint refill/DOU read function are supplied by the microcomputer on the DATA CLOCK line.

606-47. A counter circuit, the update counter, counts the clock pulses received by the multipoint shift register. It issues an UPDATE signal to the interface microcomputer after 16 clock pulses, informing the microcomputer that the multipoint shift register has been read. The microcomputer then refills, or updates, the multipoint shift register and issues an UPDATE RESET to the update counter.

606-48. Two additional isolator circuits within the guard area transfer the Reference Junction Read (RJR) signal and Vcc. The RJR signal directs the thermometer to read and update the reference junction information from the analog bus. The Vcc line supplies an enable signal to the relays, and is bussed through the interface to the 2300A Scanner Control PCB after crossing the guard.

## 606-49. RS-232-C COMMUNICATION

### 606-50. Introduction

606-51. EIA (Electronics Industries Association) Standard RS-232-C provides the electronics industry with the ground rules necessary for independent manufacturers to design and produce both data terminal and data communication equipment that conforms to a common interface requirement. As a result, a data communications system can be formed by connecting an

RS-232-C data terminal (such as the 2300A-006) to an RS-232-C data communication peripheral. This works fine on paper. However, in practice the user must be aware of the subtleties of serial binary data interchange to ensure that any two pieces of RS-232-C equipment will be compatible. For example, the two instruments must share at least one of the features from each of the following characteristics.

1. Timing Format - Synchronous or Asynchronous.
2. Transmission Mode - Simplex, half-duplex, or full duplex.
3. Baud Rate (bits per second) - 110, 150, 300, 600, 1200, 1800, 2400 4800, 9600.
4. Bits per Character - 5, 6, 7, 8.
5. Parity Bit - Odd, Even, Hi, Low, Not Used.
6. Data Interface Levels - EIA or 20 mA current loop.

606-52. Timing formats conforming to both synchronous and asynchronous operation are shown in Figure 606-7. In asynchronous operation each character is bracketed by both start and stop bits. These bits separate the characters and synchronize both the transmission and receipt of data. When data is not being sent the data line is held high. In synchronous operation a sync character is sent prior to each data stream (a data stream usually consists of a block of characters). When the line is idle a fill or sync character is continuously transmitted.

606-53. Transmission mode is an overall system requirement. It defines the communication ability of both instruments in the system configuration. Simplex indicates data transmission in one direction only. Half-duplex permits two-way communication, but not simultaneously. Full duplex permits two-way communication simultaneously. Obviously, an instrument capable of full duplex operation can be downgraded to simplex operation. However, the reverse is not possible without degrading the system capability.

606-54. Baud rate is usually selectable on the terminal device. If it is not, the manufacturer usually offers a choice of baud rates when the instrument is purchased.

606-55. Character format (bits per character and parity) is somewhat flexible between instruments. Investigate the requirements of both instruments before committing either to a system configuration.

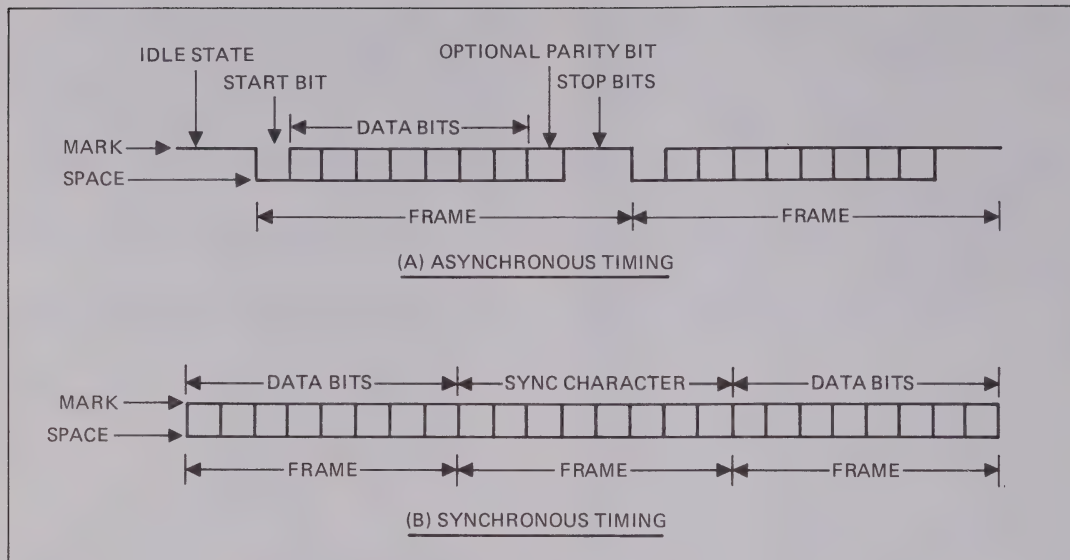


Figure 606-7. RS-232-C Timing Formats

606-56. Data interface levels can occur as either EIA voltage levels or as a 20 mA current loop. Some interfaces offer both simultaneously. The 20 mA current loop is used almost exclusively for teletypewriter, or paper tape punch/read interface. EIA voltage levels are: 1 (or OFF) = -15 to -3V dc, and 0 (or ON) = +3 to +15V dc.

606-57. Implementation (Remote Control Interface)

606-58. Subset D of the RS-232-C Standard is implemented in the Remote Control Interface. The timing format is asynchronous, transmission mode is full duplex, baud rate is switch-selectable, 8-bit ASCII characters are transferred, the parity bit is not used, and interface levels are EIA voltage levels.

606-59. Figure 606-8, the block diagram of the RS-232-C interface communication circuitry, shows the circuit sections involved in the exchange of RS-232-C data. The microcomputer controls all RS-232-C interface functions. Two outputs are available: 20 mA current loop and EIA voltage level outputs. A single input circuit (EIA voltage level) is present. The gate circuit and the scanner busy circuit control data interchange.

606-60. Eight different baud rates are switch-selectable through the baud rate switch (S1) mounted on the interface pcb. Codes established through the 4-segment switch direct the microcomputer to produce the various baud rates. Refer to Table 606-3 for a list of the codes and corresponding baud rates.

606-12

606-61. Segment number 8 (the fourth segment) of the baud rate switch controls the echo function. Some RS-232-C data communication devices require an echo of data they transmit. With switch S1, segment 8, in the closed position, the Remote Control Interface will echo received data on a bit-for-bit basis. Each bit is echoed as it is received; the interface does not wait to receive the complete ASCII character before sending an echo.

606-62. Two RS-232-C outputs are available from the interface: a current loop output and an EIA voltage level output. Both data outputs are available when Data Set Ready (CC), Clear To Send (CB), and Data Carrier Detector (CF) are high. The 20 mA current loop output circuit consists of a buffer and a driver through which the interface microcomputer transmits data. A diode between the two current loop lines provides protection for the driver in the event that the current loop connections are reversed. EIA voltage level outputs are provided through a separate driver circuit, connected in parallel with the current loop circuit, from the same microcomputer output.

606-63. Data is received on the Received Data (BB) line, buffered, and routed directly to the microcomputer. Data Set Ready (CC), Clear To Send (CB), and Data Carrier Detect (CF) must be high, or the data will not be accepted. All three signals (CC, CB, and CF) are inputs to an AND gate. If any one of them goes low, all RS-232-C interface functions will stop.

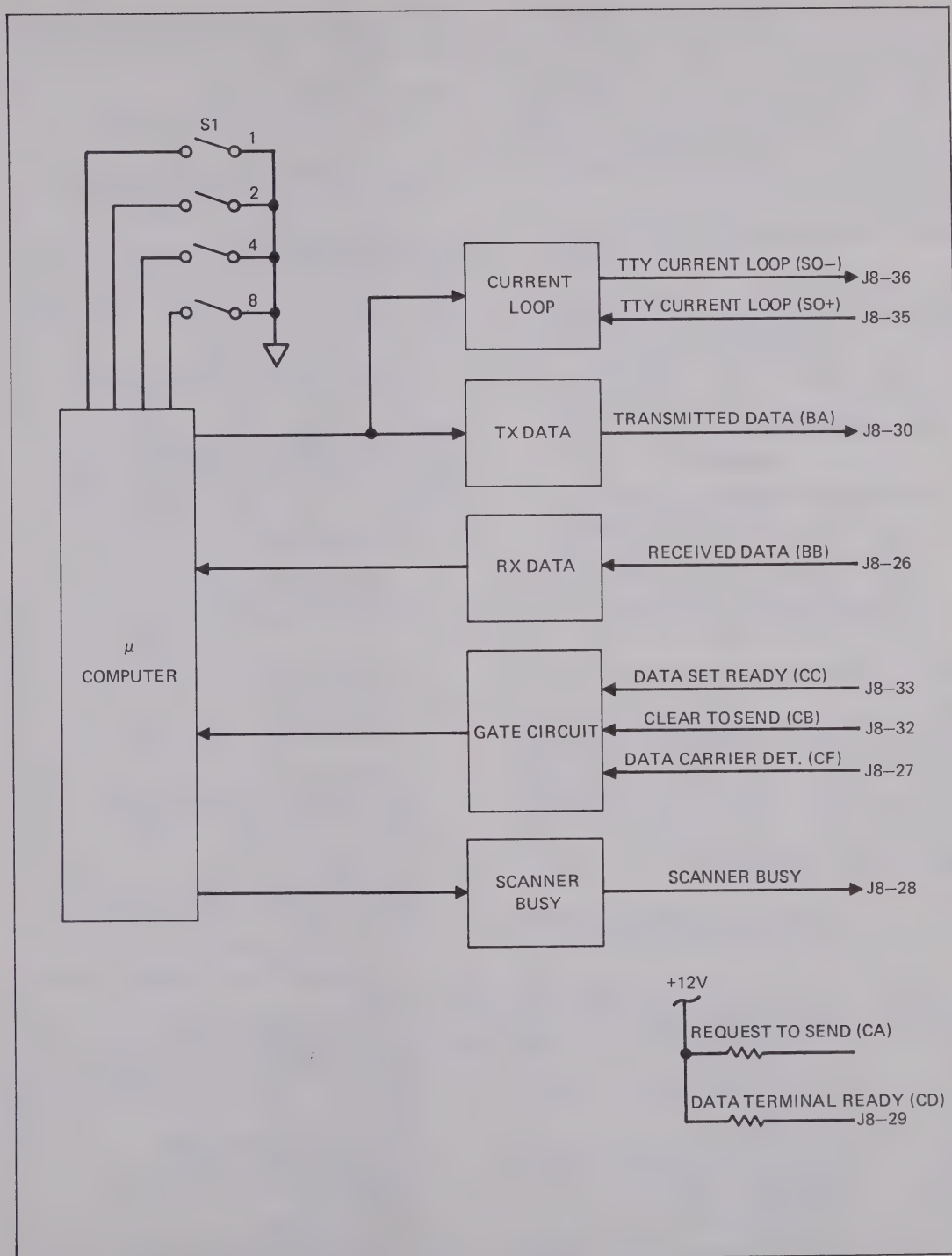


Figure 606-8. RS-232-C Interface Block Diagram

606-64. One additional circuit controls RS-232-C data interchange: the Scanner Busy circuit. When the microcomputer is performing one of its many other tasks, it sets the Scanner Busy line low through a driver circuit. When Scanner Busy is low, RS-232-C data will not be transmitted or received. When the microcomputer has completed the necessary task, it will set Scanner Busy high, and continue RS-232-C communication at the point where it previously discontinued.

606-65. RS-232-C Commands and Error Messages

606-66. All commands and error messages are transferred as ASCII characters in the RS-232-C standard format. All commands are listed in Table 606-4 in the Operating Notes section of this manual. Error Messages are discussed in the operating notes also.

## 606-67. MAINTENANCE

### WARNING

**THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN THE OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.**

## 606-68. Introduction

606-69. This section provides service, maintenance, performance test, and calibration adjustment information. A list of recommended test equipment is given in Table 606-5. If the recommended model is not available, a model with comparable specifications may be substituted.

## 606-70. Service Information

606-71. General service information, cleaning instructions, and warranty information contained in

Section 4 of the Model 2300A Scanner Mainframe manual is applicable to the Remote Control Interface option card.

## 606-72. Performance Test

### NOTE

*If a PTI printer is connected and printer power is on, the 2300A will not respond to any input until a print cycle is initiated.*

606-73. Interface option card performance testing must be performed with the interface card installed in a Model 2300A Scanner Mainframe. A digital thermometer (Model 2180A or 2190A) and a printer (Model 2020A, 2021A, or 2030A) must be connected to the 2300A as described in the 2300A installation procedures. An RS-232-C data communication device is required for thorough RS-232-C circuitry testing. Either a Thermocouple Scanner Card or an RTD Scanner Card must also be installed in the Scanner Mainframe, and the appropriate probe type must be connected to the scanner card inputs. (Refer to the applicable scanner option card installation instructions.) Use the following procedure to perform the Remote Control Interface.

1. Install the interface option and the scanner card option in the Scanner Mainframe (refer to the appropriate installation instructions).
2. Connect the digital thermometer and printer (refer to the Scanner Mainframe installation instructions).
3. Switch POWER ON to all units.
4. Manually scan all connected channels. The digital thermometer should display the correct value, and the printer should print the value displayed.
5. If the digital thermometer does not display the correct values, or if the printer does not print the correct values, refer to the Remote Control Interface troubleshooting table.

Table 606-5. Recommended Test Equipment

| EQUIPMENT TYPE         | RECOMMENDED MODEL                  |
|------------------------|------------------------------------|
| Scanner Mainframe      | Fluke Model 2300A                  |
| Scanner Option Card    | Fluke Model 2300A-002 or 2300A-003 |
| Input Device           | Thermocouple or RTD                |
| Cable Accessories      | Fluke Model Y7203 or Y7204         |
| Test Instrument        | Fluke Model 2180A or 2190A         |
| Interconnect Accessory | Fluke Model Y2026B                 |
| RS-232-C Data Set      | Hazeltine 1500                     |
| Digital Multimeter     | Fluke Model 8000A                  |
| Oscilloscope           | Tektronics Model 7603              |



6. Disconnect the printer, and connect a Y2026B RS-232-C Cable Adaptor to the DATA I/O CONNECTOR on the interface cable.
7. Connect the RS-232-C control device to one of the 25-pin connectors on the Y2026B.
8. Connect the printer to J4 (one of the 36-pin connectors) on the Y2026.
9. Enter each remote command (see Table 606-4) and verify correct scanner responses. (Enter ESC to monitor data).

#### NOTE

*The scanner will not respond until a print-cycle is initiated.*

10. Place the scanner in local operation, then enter a delay time through the RS-232-C device. The interface should respond with TYPE R FIRST on the control device.
11. Place the scanner in remote operation.
12. Enter XYZ, then a carriage return. The interface should respond with SYNTAX ERROR on the control device.
13. Enter an S and a channel number for which there is no scanner card installed. The interface should respond with the channel number and the words NOT THERE.
14. Perform the operating procedures using both the 2300A front panel controls and the remote commands (refer to the operating procedures).
15. If the Remote Control Interface does not perform as specified, refer to the troubleshooting procedure.

### 606-74. Interface Access Procedure

606-75. Option -006, the Remote Control Interface, is factory installable only. The following procedure may be used to gain access to the Remote Control Interface for servicing.

1. Switch 2300A power OFF.
2. Disconnect all input power and signal lines.
3. Release the scanner option cards by pulling the black buttons on the rear of each scanner option card.

4. Slide the scanner option cards out the rear of the Scanner Mainframe chassis.
5. Remove the four cover retaining screws in the bottom of the Scanner Mainframe case.
6. Lift the Scanner Mainframe case cover straight up to remove it.
7. Remove the four screws that secure the scanner card mounting bracket to the stand-offs on the Scanner Control PCB.
8. Remove the two screws that secure the mounting bracket to the Display/Keyboard PCB. Remove the scanner card mounting bracket.
9. Disconnect the ribbon cable from the interface option, then remove the four screws (one at each corner) that hold the interface board to the Scanner Control PCB stand-offs.
10. Reverse the preceeding steps to re-install the interface.

### 606-76. Calibration Adjustment

606-77. The Remote Control Interface does not require calibration adjustment, either periodically or after repair.

### 606-78. Troubleshooting

606-79. Troubleshooting procedures detailed in Table 606-6 should be performed only after isolating a possible malfunction to the interface option card. The table is designed to assist in isolating a malfunction to the component level. It is arranged as a tabular flow chart; when a step in the table is complete, check for a decision transfer. If no decision is required, perform the next step in the table in sequence.

### 606-80. ILLUSTRATED PARTS BREAKDOWN

606-81. All Option -006 parts are listed in Table 606-7. Each listed part is shown in an accompanying illustration. Parts ordering information is given in Section 5 of the 2300A Scanner Mainframe manual.

### 606-82. SCHEMATICS

606-83. Hardware for the Remote Control Interface (Option -006) is identical to the hardware used in Option -005, with the exception of the microcomputer mounted on the interface pcb and a second microcomputer mounted on the Scanner Control PCB. The schematic in Section 8 for Option -005 is valid for Option -006. Only the programming in the microcomputers is different.

Table 606-6. Troubleshooting Guide

| STEP NO. | ACTION                                                                                                                               | Go to the step number given for correct response |    |
|----------|--------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|----|
|          |                                                                                                                                      | YES                                              | NO |
| 1        | Install Option 006 in a Model 2300A Scanner Mainframe.                                                                               |                                                  |    |
| 2        | Connect the 2300A to a digital thermometer and, through a Y2026B RS-232 Cable Adapter , to a printer and an RS-232-C control device. |                                                  |    |
| 3        | Switch power on to all instruments.                                                                                                  |                                                  |    |
| 4        | Does the digital thermometer display accurate data?                                                                                  | 13                                               | 5  |
| 5        | Is valid data transferred across the guard circuit?                                                                                  | 7                                                | 6  |
| 6        | Check the isolator circuits within the guard circuit.                                                                                |                                                  |    |
| 7        | Does the address decode and clock-select circuit switch both clock signals to the shift register?                                    | 9                                                | 8  |
| 8        | Check the address register and clock-select gates.                                                                                   |                                                  |    |
| 9        | Is data from the thermometer shifted into and out of the DOU shift register?                                                         | 11                                               | 10 |
| 10       | Check the DOU shift register.                                                                                                        |                                                  |    |
| 11       | Is data from the interface microcomputer shifted into and out of the multipoint shift register?                                      | 13                                               | 12 |
| 12       | Check the multipoint shift register and the interface microcomputer.                                                                 |                                                  |    |
| 13       | Does the printer produce an output identical to the thermometer display?                                                             | 20                                               | 14 |
| 14       | Are the printer address switches set to the proper printer address?                                                                  | 16                                               | 15 |
| 15       | Set the proper printer address.                                                                                                      |                                                  |    |
| 16       | Are the printer address switches and data line buffers functioning?                                                                  | 18                                               | 17 |
| 17       | Repair or replace the defective component.                                                                                           |                                                  |    |
| 18       | Does the microcomputer receive data from the Scanner Control PCB?                                                                    | 20                                               | 19 |
| 19       | Check the scanner control buffers.                                                                                                   |                                                  |    |
| 20       | Does the scanner respond properly to remote commands from the RS-232-C device?                                                       | 31                                               | 21 |
| 21       | Has the proper baud rate for the controlling device in use been set on the interface pcb?                                            | 23                                               | 22 |
| 22       | Set the appropriate baud rate.                                                                                                       |                                                  |    |
| 23       | Is pin 18 of the microcomputer at a low logic level?                                                                                 | 25                                               | 24 |
| 24       | Check the control signal inputs and the control signal buffers and gate circuit.                                                     |                                                  |    |
| 25       | Is the Scanner Busy line high?                                                                                                       | 29                                               | 26 |
| 26       | Is pin 19 of the microcomputer low?                                                                                                  | 27                                               | 28 |
| 27       | Check the Scanner Busy driver.                                                                                                       |                                                  |    |
| 28       | Check the microcomputer.                                                                                                             |                                                  |    |
| 29       | Is data available on the Transmitted Data line?                                                                                      | 31                                               | 30 |
| 30       | Check the Transmitted Data driver.                                                                                                   |                                                  |    |
| 31       | Troubleshooting is complete. Refer to the performance test to verify correct interface operation.                                    |                                                  |    |

### Backdating

The -006 Option, part number 497776, is documented at revision letter C. There are no previous revisions. Post this information in Appendix 7A, Table 7A-1.

Table 606-7. Remote Control Interface

| REF<br>DES | DESCRIPTION                                                                | FLUKE<br>STOCK<br>NO. | MFG<br>SPLY<br>CODE | MFG PART NO.<br>OR TYPE     | TOT<br>QTY | REC<br>QTY | N<br>O<br>T<br>E |
|------------|----------------------------------------------------------------------------|-----------------------|---------------------|-----------------------------|------------|------------|------------------|
| -006       | ⊗ REMOTE CONTROL INTERFACE (2180A/2190A)<br>FIGURE 606-9 (2300A-4050/-006) | 2300A<br>SEE          | ORDER<br>BELOW      | OPTION -006<br>FOOTNOTE "A" |            |            |                  |
| C1         | CAP, TA, 10 UF +/-20%, 20V                                                 | 330662                | 56289               | 196D106X0020KA1             | 4          |            |                  |
| C2         | CAP, TA, 10 UF +/-20%, 20V                                                 | 330662                | 56289               | 196D106X0020KA1             | REF        |            |                  |
| C3         | CAP, TA, 10 UF +/-20%, 20V                                                 | 330662                | 56289               | 196D106X0020KA1             | REF        |            |                  |
| C4         | CAP, TA, 10 UF +/-20%, 20V                                                 | 330662                | 56289               | 196D106X0020KA1             | REF        |            |                  |
| C5         | CAP, CER, 0.22 UF +/-20%, 50V                                              | 309849                | 71590               | CW30C224K                   | 1          |            |                  |
| CR1        | DIODE, SI, HI-SPEED SWITCHING                                              | 203323                | 07910               | 1N4448                      | 1          | 1          |                  |
| H1         | SCREW, PHP, 2-56 X 1/2                                                     | 114587                | 73734               | 19006                       | 2          |            |                  |
| J8         | CONNECTOR                                                                  | 518852                | 00779               | 552742-1                    | 1          |            |                  |
| MP1        | CABLE ASSEMBLY                                                             | 521153                | 89536               | 521153                      | 1          |            |                  |
| MP2        | CABLE CLAMP                                                                | 531236                | 89536               | 531236                      | 1          |            |                  |
| MP3        | CONNECTOR, BODY (P5)                                                       | 530154                | 89536               | 530154                      | 1          |            |                  |
| MP4        | CONNECTOR, COVER                                                           | 530162                | 89536               | 530162                      | 1          |            |                  |
| MP5        | COMPONENT HOLDER                                                           | 422865                | 98159               | 2829-75-2                   | 1          |            |                  |
| P2         | SOCKET, 22-CONTACT                                                         | 443069                | 00779               | 1-583773-0                  | 1          |            |                  |
| Q1         | XSTR, SI, NPN                                                              | 218396                | 04713               | 2N3904                      | 6          | 2          |                  |
| Q2         | XSTR, SI, NPN                                                              | 218396                | 04713               | 2N3904                      | REF        |            |                  |
| Q3         | XSTR, SI, NPN                                                              | 218396                | 04713               | 2N3904                      | REF        |            |                  |
| Q4         | XSTR, SI, NPN                                                              | 218396                | 04713               | 2N3904                      | REF        |            |                  |
| Q5         | XSTR, SI, NPN                                                              | 218396                | 04713               | 2N3904                      | REF        |            |                  |
| Q6         | XSTR, SI, NPN                                                              | 218396                | 04713               | 2N3904                      | REF        |            |                  |
| Q7         | XSTR, SI, PNP                                                              | 195974                | 04713               | 2N3906                      | 1          | 1          |                  |
| R1         | RES, DEP. CAR, 2.2K +/-5%, 1/4W                                            | 343400                | 80031               | CR251-4-5P2K2               | 6          |            |                  |
| R2         | RES, DEP. CAR, 220K +/-5%, 1/4W                                            | 348953                | 80031               | CR251-4-5P220K              | 6          |            |                  |
| R3         | RES, DEP. CAR, 2.2K +/-5%, 1/4W                                            | 343400                | 80031               | CR251-4-5P2K2               | REF        |            |                  |
| R4         | RES, DEP. CAR, 220K +/-5%, 1/4W                                            | 348953                | 80031               | CR251-4-5P220K              | REF        |            |                  |
| R5         | RES, DEP. CAR, 200 +/-5%, 1/4W                                             | 441451                | 80031               | CR251-4-5P200E              | 1          |            |                  |
| R6         | RES, DEP. CAR, 10K +/-5%, 1/4W                                             | 348839                | 80031               | CR251-4-3P10K               | 4          |            |                  |
| R7         | RES, DEP. CAR, 100K +/-5%, 1/4W                                            | 348920                | 80031               | CR251-4-5P100K              | 7          |            |                  |
| R8         | RES, DEP. CAR, 47 +/-5%, 1/4W                                              | 441592                | 80031               | CR251-4-5P47E               | 5          |            |                  |
| R9         | RES, DEP. CAR, 10K +/-5%, 1/4W                                             | 348839                | 80031               | CR251-4-3P10K               | REF        |            |                  |
| R10        | RES, DEP. CAR, 100K +/-5%, 1/4W                                            | 348920                | 80031               | CR251-4-5P100K              | REF        |            |                  |
| R11        | RES, DEP. CAR, 10K +/-5%, 1/4W                                             | 348839                | 80031               | CR251-4-3P10K               | REF        |            |                  |
| R12        | RES, DEP. CAR, 47 +/-5%, 1/4W                                              | 441592                | 80031               | CR251-4-5P47E               | REF        |            |                  |
| R13        | RES, DEP. CAR, 47 +/-5%, 1/4W                                              | 441592                | 80031               | CR251-4-5P47E               | REF        |            |                  |
| R14        | RES, DEP. CAR, 47 +/-5%, 1/4W                                              | 441592                | 80031               | CR251-4-5P47E               | REF        |            |                  |
| R15        | RES, DEP. CAR, 100K +/-5%, 1/4W                                            | 348920                | 80031               | CR251-4-5P100K              | REF        |            |                  |
| R16        | RES, DEP. CAR, 100K +/-5%, 1/4W                                            | 348920                | 80031               | CR251-4-5P100K              | REF        |            |                  |
| R17        | RES, DEP. CAR, 100K +/-5%, 1/4W                                            | 348920                | 80031               | CR251-4-5P100K              | REF        |            |                  |
| R18        | RES, DEP. CAR, 47 +/-5%, 1/4W                                              | 441592                | 80031               | CR251-4-5P47E               | REF        |            |                  |
| R19        | RES, DEP. CAR, 220K +/-5%, 1/4W                                            | 348953                | 80031               | CR251-4-5P220K              | REF        |            |                  |
| R20        | RES, DEP. CAR, 2.2K +/-5%, 1/4W                                            | 343400                | 80031               | CR251-4-5P2K2               | REF        |            |                  |
| R21        | RES, DEP. CAR, 220K +/-5%, 1/4W                                            | 348953                | 80031               | CR251-4-5P220K              | REF        |            |                  |
| R22        | RES, DEP. CAR, 100K +/-5%, 1/4W                                            | 348920                | 80031               | CR251-4-5P100K              | REF        |            |                  |
| R23        | RES, DEP. CAR, 2.2K +/-5%, 1/4W                                            | 343400                | 80031               | CR251-4-5P2K2               | REF        |            |                  |
| R24        | RES, DEP. CAR, 220K +/-5%, 1/4W                                            | 348953                | 80031               | CR251-4-5P220K              | REF        |            |                  |
| R25        | RES, DEP. CAR, 2.2K +/-5%, 1/4W                                            | 343400                | 80031               | CR251-4-5P2K2               | REF        |            |                  |
| R26        | RES, DEP. CAR, 220K +/-5%, 1/4W                                            | 348953                | 80031               | CR251-4-5P220K              | REF        |            |                  |

Table 606-7. Remote Control Interface (cont)

| REF<br>DES | DESCRIPTION                               | FLUKE<br>STOCK<br>NO. | MFG<br>SPLY<br>CODE | MFG PART NO.<br>OR TYPE | TOT<br>QTY | REC<br>QTY | N<br>O<br>T<br>E |
|------------|-------------------------------------------|-----------------------|---------------------|-------------------------|------------|------------|------------------|
| R27        | RES, DEP. CAR, 2.2K +/-5%, 1/4W           | 343400                | 80031               | CR251-4-5P2K2           | REF        |            |                  |
| R28        | RES, DEP. CAR, 100K +/-5%, 1/4W           | 348920                | 80031               | CR251-4-5P100K          | REF        |            |                  |
| R29        | RES, DEP. CAR, 10K +/-5%, 1/4W            | 348839                | 80031               | CR251-4-3P10K           | REF        |            |                  |
| R31        | RES, DEP. CAR, 120 +/-5%, 1/4W            | 442293                | 80031               | CR251-4-5P120E          | 1          |            |                  |
| R37        | RES, DEP. CAR, 4.7K +/-5%, 1/4W           | 348821                | 80031               | CR251-4-5P4K7           | 2          |            |                  |
| R38        | RES, DEP. CAR, 4.7K +/-5%, 1/4W           | 348821                | 80031               | CR251-4-5P4K7           | REF        |            |                  |
| R39        | RES, DEP. CAR, 5.1K +/-5%, 1/4W           | 368712                | 80031               | CR251-4-5P5K1           | 3          |            |                  |
| R40        | RES, DEP. CAR, 5.1K +/-5%, 1/4W           | 368712                | 80031               | CR251-4-5P5K1           | REF        |            |                  |
| R41        | RES, DEP. CAR, 5.1K +/-5%, 1/4W           | 368712                | 80031               | CR251-4-5P5K1           | REF        |            |                  |
| R42        | RES, DEP. CAR, 120 +/-5%, 1/4W            | 442293                | 80031               | CR251-4-5P120E          | REF        |            |                  |
| S1         | SWITCH ASSEMBLY, 4-SPST                   | 408559                | 00779               | 435166-2                | 2          |            |                  |
| S2         | SWITCH ASSEMBLY, 4-SPST                   | 408559                | 00779               | 435166-2                | REF        |            |                  |
| U1         | ⊗IC, C-MOS, HEX, BUFFER/INVERTER          | 381830                | 02735               | CD4050AE                | 2          | 1          |                  |
| U2         | IC, OPTO-ISOLATOR                         | 380014                | 01295               | T1L116                  | 6          | 2          |                  |
| U3         | IC, OPTO-ISOLATOR                         | 380014                | 01295               | T1L116                  | REF        |            |                  |
| U4         | IC, OPTO-ISOLATOR                         | 380014                | 01295               | T1L116                  | REF        |            |                  |
| U5         | IC, OPTO-ISOLATOR                         | 380014                | 01295               | T1L116                  | REF        |            |                  |
| U6         | IC, OPTO-ISOLATOR                         | 380014                | 01295               | T1L116                  | REF        |            |                  |
| U7         | IC, OPTO-ISOLATOR                         | 380014                | 01295               | T1L116                  | REF        |            |                  |
| U8         | ⊗IC, C-MOS, HEX, INVERTER                 | 404681                | 02735               | CD4069BE                | 1          | 1          |                  |
| U9         | ⊗IC, C-MOS, QUAD, 2-INPUT AND GATE        | 408401                | 02735               | CD4081BE                | 1          | 1          |                  |
| U10        | ⊗IC, C-MOS, 18-BIT STATIC SWIFT REG       | 508432                | 04713               | MC14006BCP              | 3          | 1          |                  |
| U11        | ⊗IC, C-MOS, DUAL, "D" TYPE, F/F           | 340117                | 02735               | CD4013AE                | 1          | 1          |                  |
| U12        | ⊗IC, C-MOS, QUAD, 2-INPUT NOR GATES       | 355172                | 02735               | CD4001AE                | 1          | 1          |                  |
| U13        | ⊗IC, C-MOS, TRIPLE, 3-INPUT AND GATE      | 408807                | 02735               | CD4073BE                | 1          | 1          |                  |
| U14        | ⊗IC, C-MOS, 18-BIT STATIC SWIFT REG       | 508432                | 04713               | MC14006BCP              | REF        |            |                  |
| U15        | ⊗IC, C-MOS, DUAL 4-BIT STATIC SHIFT RGSTR | 340125                | 04713               | MC14015CP               | 1          | 1          |                  |
| U16        | ⊗IC, C-MOS, HEX, BUFFER/INVERTER          | 381830                | 02735               | CD4050AE                | REF        |            |                  |
| U17        | ⊗IC, C-MOS, HEX OPEN DRAIN BUFFERS        | 473389                | 12040               | MM74C906N               | 1          | 1          |                  |
| U18        | ⊗IC, C-MOS, 18-BIT STATIC SWIFT REG       | 508432                | 04713               | MC14006BCP              | REF        |            |                  |
| U19        | ⊗IC, C-MOS, DUAL 4-INPUT NOR GATES        | 363820                | 04713               | MC14002CP               | 1          | 1          |                  |
| U20        | IC, MICRO-PROCESSOR                       | 508424                | 89536               | 508424                  | 1          | 1          |                  |
| U21        | ⊗IC, C-MOS, HEX BUFFER/INVERTERS          | 381848                | 04713               | MC14049CP               | 1          | 1          |                  |
| U22        | IC, QUAD, LINE RECEIVER 14-PIN DIP        | 414052                | 12040               | LM1488N                 | 1          | 1          |                  |
| U23        | ⊗IC, C-MOS, TRI-STATE, HEX, NONINV BFFRS  | 407759                | 12040               | MM80C97N                | 2          | 1          |                  |
| U24        | ⊗IC, C-MOS, TRI-STATE, HEX, NONINV BFFRS  | 407759                | 12040               | MM80C97N                | REF        |            |                  |
| U25        | IC, QUAD LINE RECEIVER                    | 414045                | 12040               | LM1489                  | 1          | 1          |                  |
| U26        | ⊗IC, C-MOS, QUAD, "OR" AND "NOR" GATE     | 508416                | 04713               | MC14077BCP              | 1          | 1          |                  |
| U27        | ⊗IC, C-MOS, QUAD, 2-INPUT OR GATE         | 408393                | 02735               | CD4071BE                | 1          | 1          |                  |
| XU20       | SOCKET, IC, 40-PIN (TO U20)               | 418988                | 91506               | 340-AG39D               | 1          |            |                  |
| Y1         | CRYSTAL, QUARTZ 400 MHZ                   | 474072                | 89536               | 474072                  | 1          | 1          |                  |
| Z2         | RESISTOR NETWORK, 100K                    | 412726                | 89536               | 412726                  | 2          |            |                  |
| Z3         | RESISTOR NETWORK, 10K                     | 500710                | 89536               | 500710                  | 1          |            |                  |
| Z4         | RESISTOR NETWORK, 100K                    | 412726                | 89536               | 412726                  | REF        |            |                  |
|            | 005 OPTION CABLE (USED ON -006)           | 521153                | 89536               | 521153                  | 1          |            |                  |
|            | INSTRUCTION SHEET (-005) (-006)           | 522110                | 89536               | 522110                  | 1          |            |                  |
|            | SAME AS 005 OPTION SHEET                  |                       |                     |                         |            |            |                  |
|            | ▲ ON THE A1 ASSEMBLY, INSTALL IN U4       |                       |                     |                         |            |            |                  |
|            | FOR THE -006 OPTION THE FOLLOWING:        |                       |                     |                         |            |            |                  |
|            | U4 IC, MICRO-PROCESSOR                    | 535310                | 89536               | 535310                  | 1          | 1          |                  |
|            | U4 IC, MICRO-PROCESSOR                    | 541060                | 89536               | 541060                  | 1          | 1          |                  |
|            | U4 (PIGGY-BACK APPLICATION) ON A1         |                       |                     |                         |            |            |                  |







## **Section 7**

# **General Information**

7-1. This section of the manual contains generalized user information as well as supplemental information to the List of Replaceable Parts contained in Section 5.

## List of Abbreviations and Symbols

|                 |                             |                   |                            |                   |                                                     |
|-----------------|-----------------------------|-------------------|----------------------------|-------------------|-----------------------------------------------------|
| <b>A or amp</b> | ampere                      | <b>hf</b>         | high frequency             | <b>(+) or pos</b> | positive                                            |
| <b>ac</b>       | alternating current         | <b>Hz</b>         | hertz                      | <b>pot</b>        | potentiometer                                       |
| <b>af</b>       | audio frequency             | <b>IC</b>         | integrated circuit         | <b>p-p</b>        | peak-to-peak                                        |
| <b>a/d</b>      | analog-to-digital           | <b>if</b>         | intermediate frequency     | <b>ppm</b>        | parts per million                                   |
| <b>assy</b>     | assembly                    | <b>in</b>         | inch(es)                   | <b>PROM</b>       | programmable read-only memory                       |
| <b>AWG</b>      | american wire gauge         | <b>intl</b>       | internal                   | <b>psi</b>        | pound-force per square inch                         |
| <b>B</b>        | bel                         | <b>I/O</b>        | input/output               | <b>RAM</b>        | random-access memory                                |
| <b>bcd</b>      | binary coded decimal        | <b>k</b>          | kilo (10 <sup>3</sup> )    | <b>rf</b>         | radio frequency                                     |
| <b>°C</b>       | Celsius                     | <b>kHz</b>        | kilohertz                  | <b>rms</b>        | root mean square                                    |
| <b>cap</b>      | capacitor                   | <b>kΩ</b>         | kilohm(s)                  | <b>ROM</b>        | read-only memory                                    |
| <b>ccw</b>      | counterclockwise            | <b>kV</b>         | kilovolt(s)                | <b>s or sec</b>   | second (time)                                       |
| <b>cer</b>      | ceramic                     | <b>lf</b>         | low frequency              | <b>scope</b>      | oscilloscope                                        |
| <b>cermet</b>   | ceramic to metal(seal)      | <b>LED</b>        | light-emitting diode       | <b>SH</b>         | shield                                              |
| <b>ckt</b>      | circuit                     | <b>LSB</b>        | least significant bit      | <b>Si</b>         | silicon                                             |
| <b>cm</b>       | centimeter                  | <b>LSD</b>        | least significant digit    | <b>serno</b>      | serial number                                       |
| <b>cmrr</b>     | common mode rejection ratio | <b>M</b>          | mega (10 <sup>6</sup> )    | <b>sr</b>         | shift register                                      |
| <b>comp</b>     | composition                 | <b>m</b>          | milli (10 <sup>-3</sup> )  | <b>Ta</b>         | tantalum                                            |
| <b>cont</b>     | continue                    | <b>mA</b>         | milliampere(s)             | <b>tb</b>         | terminal board                                      |
| <b>crt</b>      | cathode-ray tube            | <b>max</b>        | maximum                    | <b>tc</b>         | temperature coefficient or temperature compensating |
| <b>cw</b>       | clockwise                   | <b>mf</b>         | metal film                 | <b>tcxo</b>       | temperature compensated crystal oscillator          |
| <b>d/a</b>      | digital-to-analog           | <b>MHz</b>        | megahertz                  | <b>tp</b>         | test point                                          |
| <b>dac</b>      | digital-to-analog converter | <b>min</b>        | minimum                    | <b>u or μ</b>     | micro (10 <sup>-6</sup> )                           |
| <b>dB</b>       | decibel                     | <b>mm</b>         | millimeter                 | <b>uhf</b>        | ultra high frequency                                |
| <b>dc</b>       | direct current              | <b>ms</b>         | millisecond                | <b>us or μs</b>   | microsecond(s) (10 <sup>-6</sup> )                  |
| <b>dmm</b>      | digital multimeter          | <b>MSB</b>        | most significant bit       | <b>uut</b>        | unit under test                                     |
| <b>dvm</b>      | digital voltmeter           | <b>MSD</b>        | most significant digit     | <b>v</b>          | volt                                                |
| <b>elect</b>    | electrolytic                | <b>MTBF</b>       | mean time between failures | <b>v</b>          | voltage                                             |
| <b>ext</b>      | external                    | <b>MTTR</b>       | mean time to repair        | <b>var</b>        | variable                                            |
| <b>F</b>        | farad                       | <b>mV</b>         | millivolt(s)               | <b>vco</b>        | voltage controlled oscillator                       |
| <b>°F</b>       | Fahrenheit                  | <b>mv</b>         | multivibrator              | <b>vhf</b>        | very high frequency                                 |
| <b>FET</b>      | Field-effect transistor     | <b>MΩ</b>         | megohm(s)                  | <b>vlf</b>        | very low frequency                                  |
| <b>ff</b>       | flip-flop                   | <b>n</b>          | nano (10 <sup>-9</sup> )   | <b>W</b>          | watt(s)                                             |
| <b>freq</b>     | frequency                   | <b>na</b>         | not applicable             | <b>ww</b>         | wire wound                                          |
| <b>FSN</b>      | federal stock number        | <b>NC</b>         | normally closed            | <b>xfmr</b>       | transformer                                         |
| <b>g</b>        | gram                        | <b>(-) or neg</b> | negative                   | <b>xstr</b>       | transistor                                          |
| <b>G</b>        | giga (10 <sup>9</sup> )     | <b>NO</b>         | normally open              | <b>xtal</b>       | crystal                                             |
| <b>gd</b>       | guard                       | <b>ns</b>         | nanosecond                 | <b>xtlo</b>       | crystal oscillator                                  |
| <b>Ge</b>       | germanium                   | <b>opnl ampli</b> | operational amplifier      | <b>Ω</b>          | ohm(s)                                              |
| <b>GHz</b>      | gigahertz                   | <b>p</b>          | pico (10 <sup>-12</sup> )  | <b>μ</b>          | micro (10 <sup>-6</sup> )                           |
| <b>gmV</b>      | guaranteed minimum value    | <b>para</b>       | paragraph                  |                   |                                                     |
| <b>gnd</b>      | ground                      | <b>pcb</b>        | printed circuit board      |                   |                                                     |
| <b>H</b>        | henry                       | <b>pF</b>         | picofarad                  |                   |                                                     |
| <b>hd</b>       | heavy duty                  | <b>pn</b>         | part number                |                   |                                                     |



# Federal Supply Codes for Manufacturers

|                                                                                                                         |                                                                                                          |                                                                                                               |                                                                                                                     |
|-------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| 00213<br>Nytronics Comp. Group Inc.<br>Subsidiary of Nytronics Inc.<br>Formerly Sage Electronics<br>Rochester, New York | 02660<br>Bunker Ramo Corp., Conn Div.<br>Formerly Amphenol-Borg<br>Electric Corp.<br>Broadview, Illinois | 04946<br>Standard Wire & Cable<br>Los Angeles, California                                                     | 06751<br>Components, Inc. Semcor Div.<br>Phoenix, Arizona                                                           |
| 00327<br>Welwyn International, Inc.<br>Westlake, Ohio                                                                   | 02799<br>Aero Capacitors, Inc.<br>Chatsworth, California                                                 | 05082<br>Replaced by 94988                                                                                    | 06860<br>Gould Automotive Div.<br>City of Industry, California                                                      |
| 00656<br>Aerovox Corp.<br>New Bedford, Massachusetts                                                                    | 03508<br>General Electric Co.<br>Semiconductor Products<br>Syracuse, New York                            | 05236<br>Jonathan Mfg. Co.<br>Fullerton, California                                                           | 06961<br>Vernitron Corp., Piezo<br>Electric Div.<br>Formerly Clevite Corp., Piezo<br>Electric Div.<br>Bedford, Ohio |
| 00686<br>Film Capacitors, Inc.<br>Passaic, New Jersey                                                                   | 03614<br>Replaced by 71400                                                                               | 05245<br>Components Corp. now<br>Corcom, Inc.<br>Chicago, Illinois                                            | 06980<br>Eimac Div.<br>Varian Associates<br>San Carlos, California                                                  |
| 00779<br>AMP Inc.<br>Harrisburg, Pennsylvania                                                                           | 03651<br>Replaced by 44655                                                                               | 05277<br>Westinghouse Electric Corp.<br>Semiconductor Div.<br>Youngwood, Pennsylvania                         | 07047<br>The Ross Milton Co.<br>South Hampton, Pennsylvania                                                         |
| 01121<br>Allen-Bradley Co.<br>Milwaukee, Wisconsin                                                                      | 03797<br>Eldema Div.<br>Genisco Technology Corp.<br>Compton, California                                  | 05278<br>Replaced by 43543                                                                                    | 07115<br>Replaced by 14674                                                                                          |
| 01281<br>TRW Electronic Comp.<br>Semiconductor Operations<br>Lawndale, California                                       | 03877<br>Transistron Electronic Corp.<br>Wakefield, Massachusetts                                        | 05279<br>Southwest Machine &<br>Plastic Co.<br>Glendora, California                                           | 07138<br>Westinghouse Electric Corp.,<br>Electronic Tube Div.<br>Horsehead, New York                                |
| 01295<br>Texas Instruments, Inc.<br>Semiconductor Group<br>Dallas, Texas                                                | 03888<br>KDI Pyrofilm Corp.<br>Whippany, New Jersey                                                      | 05397<br>Union Carbide Corp.<br>Materials Systems Div.<br>New York, New York                                  | 07233<br>TRW Electronic Components<br>Cinch Graphic<br>City of Industry, California                                 |
| 01537<br>Motorola Communications &<br>Electronics Inc.<br>Franklin Park, Illinois                                       | 03911<br>Clairex Electronics Div.<br>Clairex Corp.<br>Mt. Vernon, New York                               | 05571<br>Use 56289<br>Sprague Electric Co.<br>Pacific Div.<br>Los Angeles, California                         | 07256<br>Silicon Transistor Corp.<br>Div. of BBF Group Inc.<br>Chelmsford, Massachusetts                            |
| 01686<br>RCL Electronics Inc.<br>Manchester, New Hampshire                                                              | 03980<br>Muirhead Inc.<br>Mountainside, New Jersey                                                       | 05574<br>Viking Industries<br>Chatsworth, California                                                          | 07261<br>Aumet Corp.<br>Culver City, California                                                                     |
| 01730<br>Replaced by 73586                                                                                              | 04009<br>Arrow Hart Inc.<br>Hartford, Connecticut                                                        | 05704<br>Replaced by 16258                                                                                    | 07263<br>Fairchild Semiconductor<br>Div. of Fairchild Camera<br>& Instrument Corp.<br>Mountain View, California     |
| 01884<br>Use 56289<br>Sprague Electric Co.<br>Dearborn Electronic Div.<br>Lockwood, Florida                             | 04062<br>Replaced by 72136                                                                               | 05820<br>Wakefield Engineering Inc.<br>Wakefield, Massachusetts                                               | 07344<br>Bircher Co., Inc.<br>Rochester, New York                                                                   |
| 02114<br>Ferroxcube Corp.<br>Saugerties, New York                                                                       | 04202<br>Replaced by 81312                                                                               | 06001<br>General Electric Co.<br>Electronic Capacitor &<br>Battery Products Dept.<br>Columbia, South Carolina | 07597<br>Burndy Corp.<br>Tape/Cable Div.<br>Rochester, New York                                                     |
| 02131<br>General Instrument Corp.<br>Harris ASW Div.<br>Westwood, Maine                                                 | 04217<br>Essex International Inc.<br>Wire & Cable Div.<br>Anaheim, California                            | 06136<br>Replaced by 63743                                                                                    | 07792<br>Lerma Engineering Corp.<br>Northampton, Massachusetts                                                      |
| 02395<br>Rason Mfg. Co.<br>Brooklyn, New York                                                                           | 04221<br>Aemco, Div. of<br>Midtex Inc.<br>Mankato, Minnesota                                             | 06383<br>Panduit Corp.<br>Tinley Park, Illinois                                                               | 07910<br>Teledyne Semiconductor<br>Formerly Continental Device<br>Hawthorne, California                             |
| 02533<br>Snelgrove, C.R. Co., Ltd.<br>Don Mills, Ontario, Canada<br>M3B 1M2                                             | 04222<br>AVX Ceramics Div.<br>AVX Corp.<br>Myrtle Beach, Florida                                         | 06473<br>Bunker Ramo Corp.<br>Amphenol SAMS Div.<br>Chatsworth, California                                    | 07933<br>Use 49956<br>Raytheon Co.<br>Semiconductor Div. HQ<br>Mountain View, California                            |
| 02606<br>Fenwal Labs<br>Div. of Travenel Labs.<br>Morton Grove, Illinois                                                | 04423<br>Telonic Industries<br>Laguna Beach, California                                                  | 06555<br>Beede Electrical Instrument Co.<br>Penacook, New Hampshire                                           | 08225<br>Industro Transistor Corp.<br>Long Island City, New York                                                    |
|                                                                                                                         | 04645<br>Replaced by 75376                                                                               | 06739<br>Electron Corp.<br>Littleton, Colorado                                                                |                                                                                                                     |
|                                                                                                                         | 04713<br>Motorola Inc. Semiconductor<br>Products<br>Phoenix, Arizona                                     | 06743<br>Clevite Corp.<br>Cleveland, Ohio                                                                     |                                                                                                                     |

# Federal Supply Codes for Manufacturers (cont)

|                                                                                                                     |                                                                                              |                                                                                                                               |                                                                                                      |
|---------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|
| 08261<br>Spectra Strip Corp.<br>Garden Grove, California                                                            | 11726<br>Qualidyne Corp.<br>Santa Clara, California                                          | 13606<br>Use 56289<br>Sprague Electric Co.<br>Transistor Div.<br>Concord, New Hampshire                                       | 16299<br>Corning Glass<br>Electronic Components Div.<br>Raleigh, North Carolina                      |
| 08530<br>Reliance Mica Corp.<br>Brooklyn, New York                                                                  | 12014<br>Chicago Rivet & Machine Co.<br>Bellwood, Illinois                                   | 13839<br>Replaced by 23732                                                                                                    | 16332<br>Replaced by 28478                                                                           |
| 08806<br>General Electric Co.<br>Miniature Lamp Products Dept<br>Cleveland, Ohio                                    | 12040<br>National Semiconductor Corp.<br>Danbury, Connecticut                                | 14099<br>Semtech Corp.<br>Newbury Park, California                                                                            | 16473<br>Cambridge Scientific Ind.<br>Div. of Chemed Corporation<br>Cambridge, Maryland              |
| 08863<br>Nylomatic Corp.<br>Norrisville, Pennsylvania                                                               | 12060<br>Diodes, Inc.<br>Chatsworth, California                                              | 14140<br>Edison Electronic Div.<br>Mc Gray-Edison Co.<br>Manchester, New Hampshire                                            | 16742<br>Paramount Plastics<br>Fabricators, Inc.<br>Downey, California                               |
| 08988<br>Use 53085<br>Skottie Electronics Inc.<br>Archbald, Pennsylvania                                            | 12136<br>Philadelphia Handle Co.<br>Camden, New Jersey                                       | 14193<br>Cal-R-Inc. formerly<br>California Resistor, Corp.<br>Santa Monica, California                                        | 16758<br>Delco Electronics<br>Div. of General Motors Corp.<br>Kokomo, Indiana                        |
| 09214<br>G.E. Co. Semi-Conductor<br>Products Dept.<br>Power Semi-Conductor<br>Products OPN Sec.<br>Auburn, New York | 12300<br>Potter-Brumfield Div.<br>AMF Canada LTD.<br>Guelph, Ontario, Canada                 | 14298<br>American Components, Inc.<br>an Insilco Co.<br>Conshohocken, Pennsylvania                                            | 17001<br>Replaced by 71468                                                                           |
| 09353<br>C and K Components<br>Watertown, Massachusetts                                                             | 12323<br>Presin Co., Inc.<br>Shelton, Connecticut                                            | 14655<br>Cornell-Dublier Electronics<br>Division of Federal Pacific<br>Electric Co. Govt. Control Dept.<br>Newark, New Jersey | 17069<br>Circuit Structures Lab.<br>Burbank, California                                              |
| 09423<br>Scientific Components, Inc.<br>Santa Barbara, California                                                   | 12327<br>Freeway Corp. formerly<br>Freeway Washer & Stamping Co.<br>Cleveland, Ohio          | 14752<br>Electro Cube Inc.<br>San Gabriel, California                                                                         | 17338<br>High Pressure Eng. Co., Inc.<br>Oklahoma City, Oklahoma                                     |
| 09922<br>Burndy Corp.<br>Norwalk, Connecticut                                                                       | 12443<br>The Budd Co. Polychem Products<br>Plastic Products Div.<br>Bridgeport, Pennsylvania | 14869<br>Replaced by 96853                                                                                                    | 17545<br>Atlantic Semiconductors, Inc.<br>Asbury Park, New Jersey                                    |
| 09969<br>Dale Electronics Inc.<br>Yankton, S. Dakota                                                                | 12615<br>U.S. Terminals Inc.<br>Cincinnati, Ohio                                             | 14936<br>General Instrument Corp.<br>Semi Conductor Products Group<br>Hicksville, New York                                    | 17856<br>Siliconix, Inc.<br>Santa Clara, California                                                  |
| 10059<br>Barker Engineering Corp.<br>Formerly Amerace, Amerace<br>ESNA Corp.<br>Kenilworth, New Jersey              | 12617<br>Hamlin Inc.<br>Lake Mills, Wisconsin                                                | 15636<br>Elec-Trol Inc.<br>Saugus, California                                                                                 | 17870<br>Replaced by 14140                                                                           |
| 11236<br>CTS of Berne<br>Berne, Indiana                                                                             | 12697<br>Ciarostat Mfg. Co.<br>Dover, New Hampshire                                          | 15801<br>Fenwal Electronics Inc.<br>Div. of Kidde Walter and Co., Inc.<br>Framingham, Massachusetts                           | 18178<br>Vactec Inc.<br>Maryland Heights, Missouri                                                   |
| 11237<br>CTS Keene Inc.<br>Paso Robles, California                                                                  | 12749<br>James Electronics<br>Chicago, Illinois                                              | 15818<br>Teledyne Semiconductors,<br>formerly Amelco Semiconductor<br>Mountain View, California                               | 18324<br>Signetics Corp.<br>Sunnyvale, California                                                    |
| 11358<br>CBS Electronic Div.<br>Columbia Broadcasting System<br>Newburyport, Minnesota                              | 12856<br>Micrometals<br>Sierra Madre, California                                             | 15849<br>Litton Systems Inc. Useco Div.<br>formerly Useco Inc.<br>Van Nuys, California                                        | 18612<br>Vishay Resistor Products Div.<br>Vishay Intertechnology Inc.<br>Malvern, Pennsylvania       |
| 11403<br>Best Products Co.<br>Chicago, Illinois                                                                     | 12954<br>Dickson Electronics Corp.<br>Scottsdale, Arizona                                    | 15898<br>International Business<br>Machines Corp.<br>Essex Junction, Vermont                                                  | 18736<br>Voltronics Corp.<br>Hanover, New Jersey                                                     |
| 11503<br>Keystone Columbia Inc.<br>Warren, Michigan                                                                 | 12969<br>Unitrode Corp.<br>Watertown, Massachusetts                                          | 15909<br>Replaced by 14140                                                                                                    | 18927<br>GTE Sylvania Inc.<br>Precision Material Group<br>Parts Division<br>Titusville, Pennsylvania |
| 11532<br>Teledyne Relays<br>Hawthorne, California                                                                   | 13103<br>Thermalloy Co., Inc.<br>Dallas, Texas                                               | 16258<br>Space-Lok Inc.<br>Burbank, California                                                                                | 19451<br>Perine Machinery & Supply Co.<br>Seattle, Washington                                        |
| 11711<br>General Instrument Corp.<br>Rectifier Division<br>Hicksville, New York                                     | 13327<br>Solitron Devices Inc.<br>Tappan, New York                                           |                                                                                                                               | 19701<br>Electro-Midland Corp.<br>Mepco-Electra Inc.<br>Mineral Wells, Texas                         |
|                                                                                                                     | 13511<br>Amphenol Cadre Div.<br>Bunker-Ramo Corp.<br>Los Gatos, California                   |                                                                                                                               | 20584<br>Enochs Mfg. Inc.<br>Indianapolis, Indiana                                                   |

## Federal Supply Codes for Manufacturers (cont)

|                                                                                                           |                                                                                                |                                                                                                  |                                                                                                                  |
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| 20891<br>Self-Organizing Systems, Inc.<br>Dallas, Texas                                                   | 28480<br>Hewlett Packard Co.<br>Corporate HQ<br>Palo Alto, California                          | 43543<br>Nytronics Inc.<br>Transformer Co. Div.<br>Geneva, New York                              | 70903<br>Belden Corp.<br>Geneva, Illinois                                                                        |
| 21604<br>Buchey Stamping Co.<br>Columbus, Ohio                                                            | 28520<br>Heyman Mfg. Co.<br>Kenilworth, New Jersey                                             | 44655<br>Ohmite Mfg. Co.<br>Skokie, Illinois                                                     | 71002<br>Birnbach Radio Co., Inc.<br>Freeport, New York                                                          |
| 21845<br>Solitron Devices Inc.<br>Transistor Division<br>Riviera Beach, Florida                           | 29083<br>Monsanto, Co., Inc.<br>Santa Clara, California                                        | 49671<br>RCA Corp.<br>New York, New York                                                         | 71400<br>Bussmann Mfg.<br>Div. of McGraw-Edison Co.<br>Saint Louis, Missouri                                     |
| 22767<br>ITT Semiconductors<br>Palo Alto, California                                                      | 29604<br>Stackpole Components Co.<br>Raleigh, North Carolina                                   | 49956<br>Raytheon Company<br>Lexington, Massachusetts                                            | 71450<br>CTS Corp.<br>Elkhart, Indiana                                                                           |
| 23050<br>Product Comp. Corp.<br>Mount Vernon, New York                                                    | 30148<br>AB Enterprise Inc.<br>Ahoskie, North Carolina                                         | 50088<br>Mostek Corp.<br>Carrollton, Texas                                                       | 71468<br>ITT Cannon Electric Inc.<br>Santa Ana, California                                                       |
| 23732<br>Tracor Inc.<br>Rockville, Maryland                                                               | 30323<br>Illinois Tool Works, Inc.<br>Chicago, Illinois                                        | 50579<br>Litronix Inc.<br>Cupertino, California                                                  | 71482<br>Clare, C.P. & Co.<br>Chicago, Illinois                                                                  |
| 23880<br>Stanford Applied Engrng.<br>Santa Clara, California                                              | 31091<br>Optimax Inc.<br>Colmar, Pennsylvania                                                  | 51605<br>Scientific Components Inc.<br>Linden, New Jersey                                        | 71590<br>Centrelab Electronics<br>Div. of Globe Union Inc.<br>Milwaukee, Wisconsin                               |
| 23936<br>Pamotor Div., Wm. J. Purdy Co.<br>Burlingame, California                                         | 32539<br>Mura Corp.<br>Great Neck, New York                                                    | 53021<br>Sangamo Electric Co.<br>Springfield, Illinois                                           | 71707<br>Coto Coil Co., Inc.<br>Providence, Rhode Island                                                         |
| 24248<br>Replaced by 94222                                                                                | 32767<br>Griffith Plastic Corp.<br>Burlingame, California                                      | 54294<br>Cutler-Hammer Inc. formerly<br>Shallcross, A Cutter-Hammer Co.<br>Selma, North Carolina | 71744<br>Chicago Miniature Lamp Works<br>Chicago, Illinois                                                       |
| 24355<br>Analog Devices Inc.<br>Norwood, Massachusetts                                                    | 32879<br>Advanced Mechanical<br>Components<br>Northridge, California                           | 55026<br>Simpson Electric Co.<br>Div. of Am. Gage and Mach. Co.<br>Elgin, Illinois               | 71785<br>TRW Electronics Components<br>Cinch Connector Operations Div.<br>Elk Grove Village<br>Chicago, Illinois |
| 24655<br>General Radio<br>Concord, Massachusetts                                                          | 32897<br>Erie Technological Products, Inc.<br>Frequency Control Div.<br>Carlisle, Pennsylvania | 56289<br>Sprague Electric Co.<br>North Adams, Massachusetts                                      | 72005<br>Wilber B. Driver Co.<br>Newark, New Jersey                                                              |
| 24759<br>Lenox Fugle Electronics Inc.<br>South Plainfield, New Jersey                                     | 32997<br>Bourns Inc.<br>Trimpot Products Division<br>Riverside, California                     | 58474<br>Superior Electric Co.<br>Bristol, Connecticut                                           | 72092<br>Replaced by 06980                                                                                       |
| 25088<br>Siemen Corp.<br>Isilen, New Jersey                                                               | 33173<br>General Electric Co.<br>Products Dept.<br>Owensboro, Kentucky                         | 60399<br>Torin Corp. formerly<br>Torrington Mfg. Co.<br>Torrington, Connecticut                  | 72136<br>Electro Motive Mfg. Co.<br>Williamantic, Connecticut                                                    |
| 25403<br>Amperex Electronic Corp.<br>Semiconductor &<br>Micro-Circuits Div.<br>Slatersville, Rhode Island | 34333<br>Silicon General<br>Westminister, California                                           | 63743<br>Ward Leonard Electric Co., Inc.<br>Mount Vernon, New York                               | 72259<br>Nytronics Inc.<br>Pelham Manor, New Jersey                                                              |
| 27014<br>National Semiconductor Corp.<br>Santa Clara, California                                          | 34335<br>Advanced Micro Devices<br>Sunnyvale, California                                       | 64834<br>West Mfg. Co.<br>San Francisco, California                                              | 72619<br>Dialight Div.<br>Amperex Electronic Corp.<br>Brooklyn, New York                                         |
| 27264<br>Molex Products<br>Downers Grove, Illinois                                                        | 34802<br>Electromotive Inc.<br>Kenilworth, New Jersey                                          | 65092<br>Weston Instruments Inc.<br>Newark, New Jersey                                           | 72653<br>G.C. Electronics<br>Div. of Hydrometals, Inc.<br>Brooklyn, New York                                     |
| 28213<br>Minnesota Mining & Mfg. Co.<br>Consumer Products Div.<br>St. Paul, Minnesota                     | 37942<br>P.R. Mallory & Co., Inc.<br>Indianapolis, Indiana                                     | 66150<br>Winslow Tele-Tronics Inc.<br>Eaton Town, New Jersey                                     | 72665<br>Replaced by 90303                                                                                       |
| 28425<br>Serv-/Link formerly<br>Bohannon Industries<br>Fort Worth, Texas                                  | 42498<br>National Radio<br>Melrose, Massachusetts                                              | 70485<br>Atlantic India Rubber Works<br>Chicago, Illinois                                        | 72794<br>Dzus Fastener Co., Inc.<br>West Islip, New York                                                         |
| 28478<br>Deltrol Controls Div.<br>Deltrol Corporation<br>Milwaukee, Wisconsin                             |                                                                                                | 70563<br>Amperite Company<br>Union City, New Jersey                                              | 72928<br>Gulton Ind. Inc.<br>Gudeman Div.<br>Chicago, Illinois                                                   |

# Federal Supply Codes for Manufacturers (cont)

|                                                                                          |                                                                                                         |                                                                                            |                                                                                                                |
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| 72982<br>Erie Tech. Products Inc.<br>Erie, Pennsylvania                                  | 75382<br>Kulka Electric Corp.<br>Mount Vernon, New York                                                 | 80583<br>Hammarlund Mfg. Co., Inc.<br>Red Bank, New Jersey                                 | 83594<br>Burroughs Corp.<br>Electronic Components Div.<br>Plainfield, New Jersey                               |
| 73138<br>Bechman Instrument Inc.<br>Helipot Division<br>Fullerton, California            | 75915<br>Littlefuse Inc.<br>Des Plaines, Illinois                                                       | 80640<br>Arnold Stevens, Inc.<br>South Boston, Massachusetts                               | 83740<br>Union Carbide Corp.<br>Battery Products Div.<br>formerly Consumer Products Div.<br>New York, New York |
| 73293<br>Hughes Aircraft Co.<br>Electron Dynamics Div.<br>Torrance, California           | 76854<br>Oak Industries Inc.<br>Switch Div.<br>Crystal Lake, Illinois                                   | 81073<br>Grayhill, Inc.<br>La Grange, Illinois                                             | 84171<br>Arco Electronics<br>Great Neck, New York                                                              |
| 73445<br>Amperex Electronic Corp.<br>Hicksville, New York                                | 77342<br>AMF Inc.<br>Potter & Brumfield Div.<br>Princeton, Indiana                                      | 81312<br>Winchester Electronics<br>Div. of Litton Industries Inc.<br>Oakville, Connecticut | 84411<br>TRW Electronic Components<br>TRW Capacitors<br>Ogallala, Nebraska                                     |
| 73559<br>Carling Electric Inc.<br>West Hartford, Connecticut                             | 77638<br>General Instrument Corp.<br>Rectifier Division<br>Brooklyn, New York                           | 81483<br>Therm-O-Disc Inc.<br>Mansfield, Ohio                                              | 84613<br>Fuse Indicator Corp.<br>Rockville, Maryland                                                           |
| 73586<br>Circle F Industries<br>Trenton, New Jersey                                      | 77969<br>Rubbercraft Corp. of CA. LTD.<br>Torrance, California                                          | 81483<br>International Rectifier Corp.<br>Los Angeles, California                          | 84682<br>Essex International Inc.<br>Industrial Wire Div.<br>Peabody, Massachusetts                            |
| 73734<br>Federal Screw Products, Inc.<br>Chicago, Illinois                               | 78189<br>Shakeproof<br>Div. of Illinois Tool Works Inc.<br>Elgin, Illinois                              | 81590<br>Korry Mfg. Co.<br>Seattle, Washington                                             | 86577<br>Precision Metal Products<br>of Malden Inc.<br>Stoneham, Massachusetts                                 |
| 73743<br>Fischer Special Mfg. Co.<br>Cincinnati, Ohio                                    | 78277<br>Sigma Instruments, Inc.<br>South Braintree, Massachusetts                                      | 81741<br>Chicago Lock Co.<br>Chicago, Illinois                                             | 86684<br>Radio Corp. of America<br>Electronic Components Div.<br>Harrison, New Jersey                          |
| 73899<br>JFD Electronics Co.<br>Components Corp.<br>Brooklyn, New York                   | 78488<br>Stackpole Carbon Co.<br>Saint Marys, Pennsylvania                                              | 82305<br>Palmer Electronics Corp.<br>South Gate, California                                | 86928<br>Seastrom Mfg. Co., Inc.<br>Glendale, California                                                       |
| 73949<br>Guardian Electric Mfg. Co.<br>Chicago, Illinois                                 | 78553<br>Eaton Corp. Engineered<br>Fastener Div.<br>Tinnerman Plant<br>Cleveland, Ohio                  | 82389<br>Switchcraft Inc.<br>Chicago, Illinois                                             | 87034<br>Illuminated Products Inc.<br>Subsidiary of Oak Industries Inc.<br>Anahiem, California                 |
| 74199<br>Quan Nichols Co.<br>Chicago, Illinois                                           | 79136<br>Waldes Kohinoor Inc.<br>Long Island City, New York                                             | 82415<br>North American Phillips<br>Controls Corp.<br>Frederick, Maryland                  | 88219<br>Gould Inc.<br>Industrial Div.<br>Trenton, New Jersey                                                  |
| 74217<br>Radio Switch Corp.<br>Marlboro, New Jersey                                      | 79497<br>Western Rubber Company<br>Goshen, Indiana                                                      | 82872<br>Roanwell Corp.<br>New York, New York                                              | 88245<br>Litton Systems Inc.<br>Usecos Div.<br>Van Nuys, California                                            |
| 74276<br>Signalite Div.<br>General Instrument Corp.<br>Neptune, New Jersey               | 79963<br>Zierick Mfg. Corp.<br>Mt. Kisko, New York                                                      | 82877<br>Rotron Inc.<br>Woodstock, New York                                                | 88419<br>Cornell-Dublier Electronic Div.<br>Federal Pacific Co.<br>Fuquay-Varian, North Carolina               |
| 74306<br>Piezo Crystal Co.<br>Carlisle, Pennsylvania                                     | 80031<br>Electro-Midland Corp.<br>Mepco Div.<br>A North American Phillips Co.<br>Norristown, New Jersey | 82879<br>ITT Royal Electric Div.<br>Pawtucket, Rhode Island                                | 88486<br>Plastic Wire & Cable<br>Jewitt City, Connecticut                                                      |
| 74542<br>Hoyt Elect. Instr. Works<br>Penacook, New Hampshire                             | 80145<br>LFE Corp., Process Control Div.<br>formerly API Instrument Co.<br>Chesterland, Ohio            | 83003<br>Varo Inc.<br>Garland, Texas                                                       | 88690<br>Replaced by 04217                                                                                     |
| 74970<br>Johnson E.F., Co.<br>Waseca, Minnesota                                          | 80183<br>Use 56289<br>Sprague Products<br>North Adams, Massachusetts                                    | 83058<br>The Carr Co., United Can Div.<br>of TRW<br>Cambridge, Massachusetts               | 89536<br>John Fluke Mfg. Co., Inc.<br>Seattle, Washington                                                      |
| 75042<br>TRW Electronics Components<br>IRC Fixed Resistors<br>Philadelphia, Pennsylvania | 80294<br>Bourns Inc., Instrument Div.<br>Riverside, California                                          | 83298<br>Bendix Corp.<br>Electric Power Div.<br>Eatontown, New Jersey                      | 89730<br>G.E. Co., Newark Lamp Works<br>Newark, New Jersey                                                     |
| 75376<br>Kurz-Kasch Inc.<br>Dayton, Ohio                                                 |                                                                                                         | 83330<br>Herman H. Smith, Inc.<br>Brooklyn, New York                                       |                                                                                                                |
| 75378<br>CTS Knights Inc.<br>Sandwich, Illinois                                          |                                                                                                         | 83478<br>Rubbercraft Corp.<br>of America, Inc.<br>West Haven, Connecticut                  |                                                                                                                |



# Federal Supply Codes for Manufacturers (cont)

90201  
Mallory Capacitor Co.  
Div. of P.R. Mallory Co., Inc.  
Indianapolis, Indiana

90211  
Use 56365  
Square D Co.  
Chicago, Illinois

90215  
Best Stamp & Mfg. Co.  
Kansas City, Missouri

90303  
Mallory Battery Co.  
Div. of Mallory Co., Inc.  
Tarrytown, New York

91094  
Essex International Inc.  
Suglex/IWP Div.  
Newmarket, New Hampshire

91293  
Johanson Mfg. Co.  
Boonton, New Jersey

91407  
Replaced by 58474

91502  
Associated Machine  
Santa Clara, California

91506  
Augat Inc.  
Attleboro, Massachusetts

91637  
Dale Electronics Inc.  
Columbus, Nebraska

91662  
Elco Corp.  
Willow Grove, Pennsylvania

91737  
Use 71468  
Gremar Mfg. Co., Inc.  
ITT Cannon/Gremar  
Santa Ana, California

91802  
Industrial Devices, Inc.  
Edgewater, New Jersey

91833  
Keystone Electronics Corp.  
New York, New York

91836  
King's Electronics Co., Inc.  
Tuckahoe, New York

91929  
Honeywell Inc.  
Micro Switch Div.  
Freeport, Illinois

91934  
Miller Electric Co., Inc.  
Div. of Aunet  
Woonsocket, Rhode Island

92194  
Alpha Wire Corp.  
Elizabeth, New Jersey

93332  
Sylvania Electric Products  
Semiconductor Products Div.  
Woburn, Massachusetts

94145  
Replaced by 49956

94154  
Use 94988  
Wagner Electric Corp.  
Tung-Sol Div.  
Newark, New Jersey

94222  
Southco Inc. formerly  
South Chester Corp.  
Lester, Pennsylvania

95146  
Alco Electronic Products Inc.  
Lawrence, Massachusetts

95263  
Leecraft Mfg. Co.  
Long Island City, New York

95264  
Replaced by 98278

95275  
Vitramon Inc.  
Bridgeport, Connecticut

95303  
RCA Corp.  
Receiving Tube Div.  
Cincinnati, Ohio

95348  
Gordo's Corp.  
Bloomfield, New Jersey

95354  
Methode Mfg. Corp.  
Rolling Meadows, Illinois

95712  
Bendix Corp.  
Electrical Components Div.  
Microwave Devices Plant  
Franklin, Indiana

95987  
Weckesser Co. Inc.  
Chicago, Illinois

96733  
San Fernando Electric Mfg. Co.  
San Fernando, California

96853  
Gulton Industries Inc.  
Measurement and Controls Div.  
formerly Rustrak Instruments Co.  
Manchester, New Hampshire

96881  
Thomson Industries, Inc.  
Manhasset, New York

97540  
Master Mobile Mounts, Div. of  
Whitehall Electronics Corp.  
Ft. Meyers, Florida

97913  
Industrial Electronic  
Hardware Corp.  
New York, New York

97945  
Penwalt Corp.  
SS White Industrial Products Div.  
Piscataway, New Jersey

97966  
Replaced by 11358

98094  
Replaced by 49956

98159  
Rubber-Teck, Inc.  
Gardena, California

98278  
Malco A Microdot Co., Inc.  
Connector & Cable Div.  
Pasadena, California

98291  
Sealectro Corp.  
Mamaroneck, New York

98388  
Royal Industries  
Products Div.  
San Diego, California

98743  
Replaced by 12749

98925  
Replaced by 14433

99120  
Plastic Capacitors, Inc.  
Chicago, Illinois

99217  
Bell Industries Elect.  
Comp. Div.  
formerly Southern Elect. Div.  
Burbank, California

99392  
STM  
Oakland, California

99515  
ITT Jennings Monrovia Plant  
Div. of ITT Jennings formerly  
Marshall Industries Capacitor Div.  
Monrovia, California

99779  
Use 29587  
Bunker-Ramo Corp.  
Barnes Div.  
Landsdowne, Pennsylvania

99800  
American Precision Industries Inc.  
Delevan Division  
East Aurora, New York

99942  
Centrelab Semiconductor  
Centrelab Electronics Div. of  
Globe-Union Inc.  
El Monte, California

Toyo Electronics  
(R-Ohm Corp.)  
Irvine, California

National Connector  
Minneapolis, Minnesota





# U.S. SALES AREAS for all Fluke products

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                     |
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West Germany  
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Japan Branch  
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|                |               |
|----------------|---------------|
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| Bornholm       | Rodhos        |
| Botswana       | Russia        |
| Chad           | Sardinia      |
| Corsica        | Saudia Arabia |
| Czechoslovakia | Scotland      |
| Dubai          | Senegal       |
| Ethiopia       | Sierra Leone  |
| Guinea         | Somalia       |
| Ibiza          | Togo          |
| Iceland        | Upper Volta   |
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## Appendix 7A

# Manual Change Information

### INTRODUCTION

This appendix contains information necessary to backdate the manual to conform with earlier pcb configurations. To identify the configuration of the pcb's used in your instrument, refer to the revision letter (marked in ink) on the component side of each pcb assembly. Table 7A-1 defines the assembly revision levels documented in this manual.

### NEWER INSTRUMENTS

As changes and improvements are made to the instrument, they are identified by incrementing the

revision letter marked on the affected pcb assembly. These changes are documented on a supplemental change/errata sheet which, when applicable, is inserted at the front of the manual.

### OLDER INSTRUMENTS

To backdate this manual to conform with earlier assembly revision levels, perform the changes indicated in Table 7A-1.

### CHANGES

There are no backdating changes at this printing. All pcb assemblies are documented at their original revision level.

[illegible]

- \* X = The PCB revision levels documented in this manual.
- = These revision letters were never used in the instrument.
- = No revision letter on the PCB.

# Section 8

## Schematic Diagrams

### TABLE OF CONTENTS

| FIGURE | TITLE                                                  | PAGE |
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| 8-4.   | Option -002 Thermocouple Scanner PCB Assembly .....    | 8-8  |
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| 8-6.   | Option -005 Accessory Bus Interface PCB Assembly ..... | 8-12 |



|              |                                        |
|--------------|----------------------------------------|
| A0 - A3      | Printer Address                        |
| ADRVL        | Address Valid (printer)                |
| ACK          | Acknowledge                            |
| DS1          | Digit Strobe 1                         |
| DS2          | Digit Strobe 2                         |
| DS3          | Digit Strobe 3                         |
| DP           | Decimal Point                          |
| DATA TO      | Serial Data to Scanner Control         |
| DATA FROM    | Serial Data from Scanner Control       |
| DVL          | Data Valid                             |
| DTACK        | Data Acknowledge                       |
| DATVL        | Data Valid (printer)                   |
| D0 - D7      | Printer Data Lines                     |
| DATA CLK     | Scanner Clock                          |
| DCLK         | Thermometer Clock                      |
| DOU DATA     | Thermometer Output Data                |
| FE-A         | Function Enable A                      |
| FE-B         | Function Enable B                      |
| KYBS         | Keyboard Select                        |
| NUDGE.       | Initiation Signal to Scanner Extenders |
| M.P. DATA    | Multipoint Data to Thermometer         |
| RJR          | Reference Junction Read to Thermometer |
| READY        | Ready                                  |
| RESET        | Reset                                  |
| RE A         | Relay Enable A                         |
| RE B         | Relay Enable B                         |
| SE A         | Skip Enable A                          |
| SE B         | Skip Enable B                          |
| TRIGGER      | Trigger to Thermometer                 |
| UPDATE       | Counter Update                         |
| UPDATE RESET | Counter Update Reset                   |

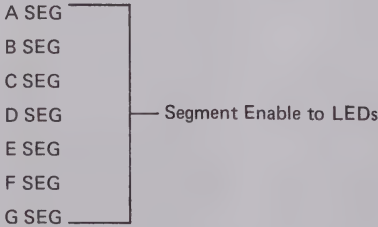


Figure 8-1. Mnemonics

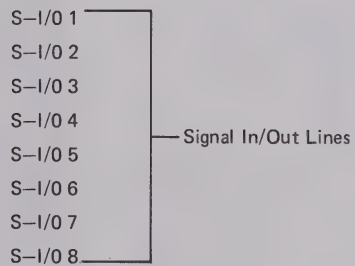
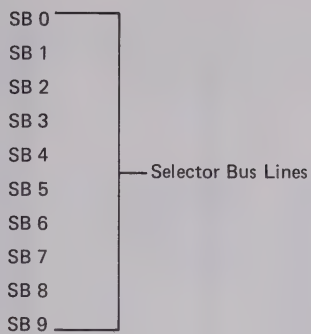
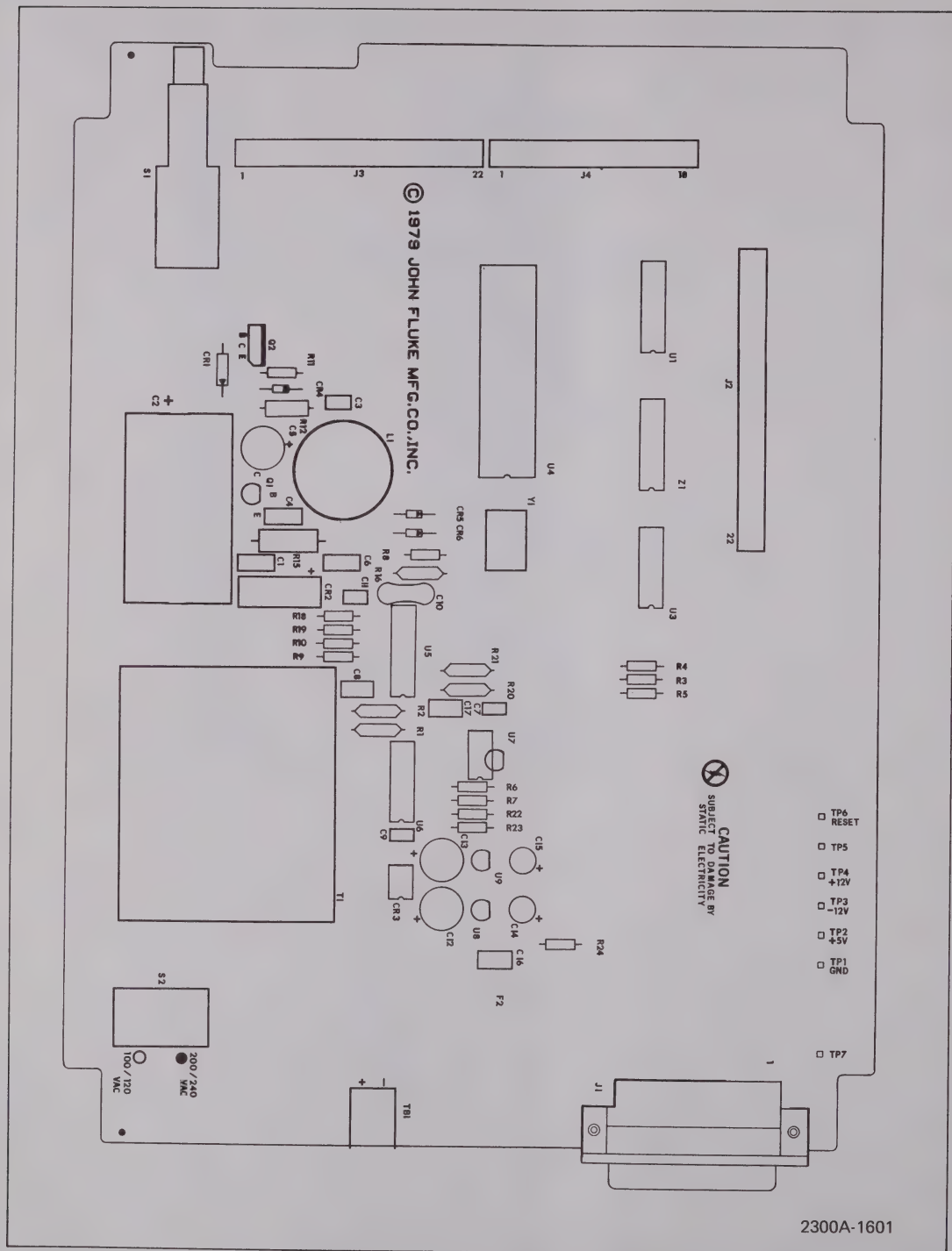
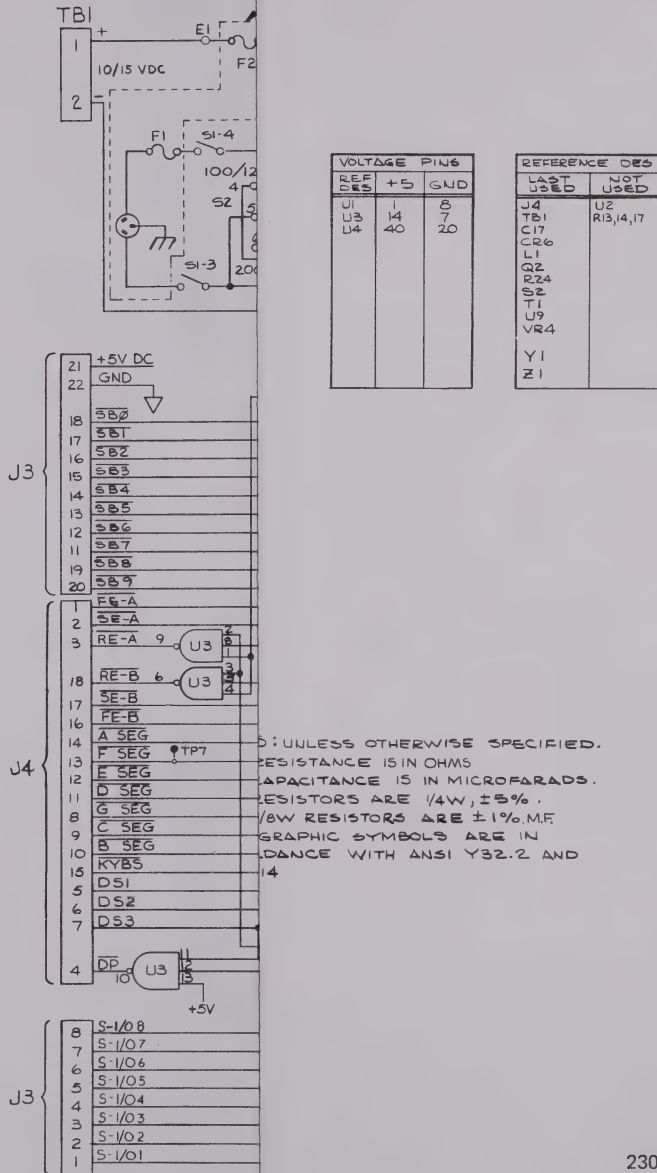


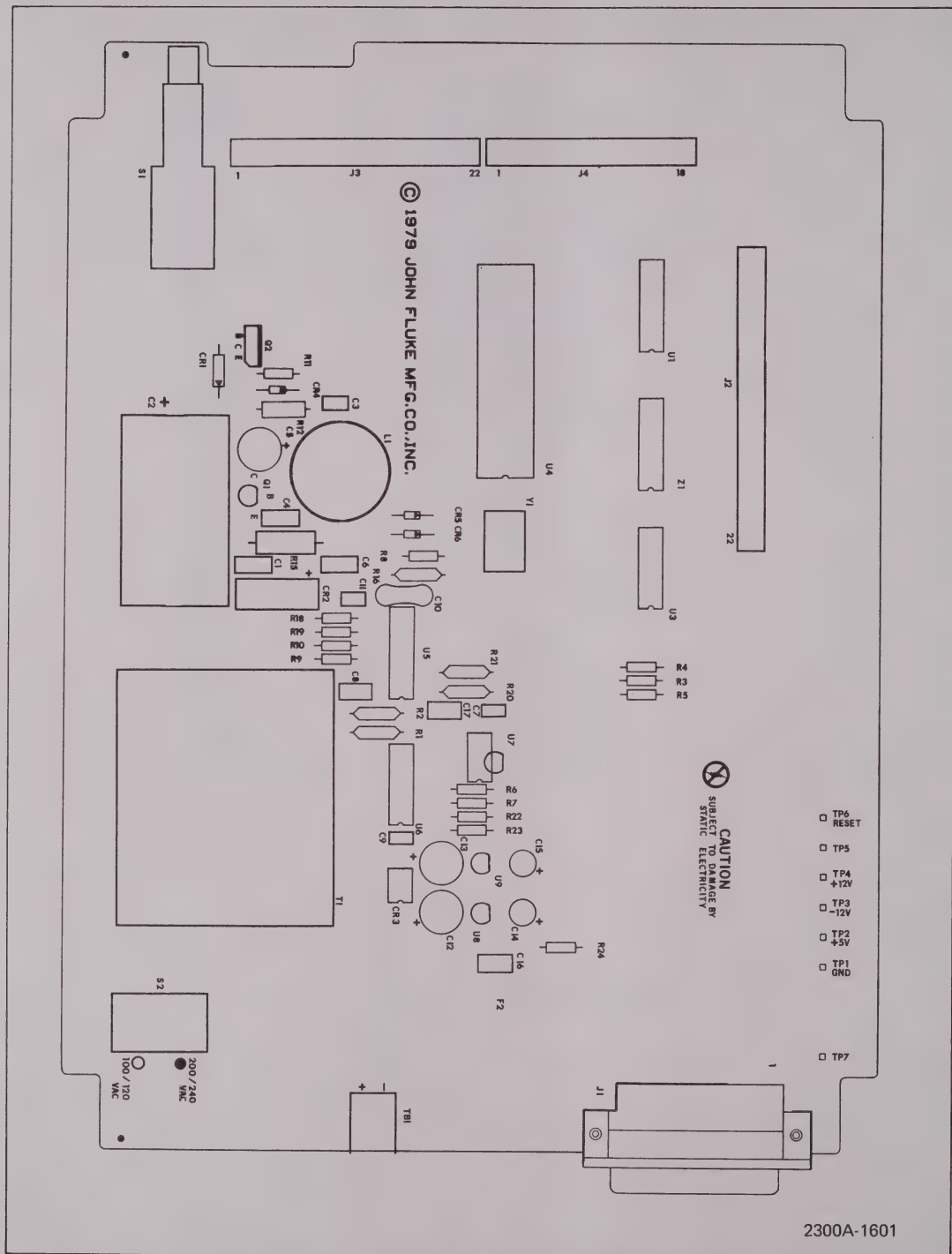
Figure 8-1. Mnemonics (cont)





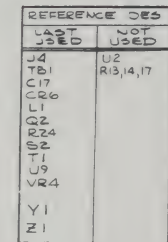
2300A-1001

Figure 8-2. A1 Scanner Control PCB Assembly (cont)



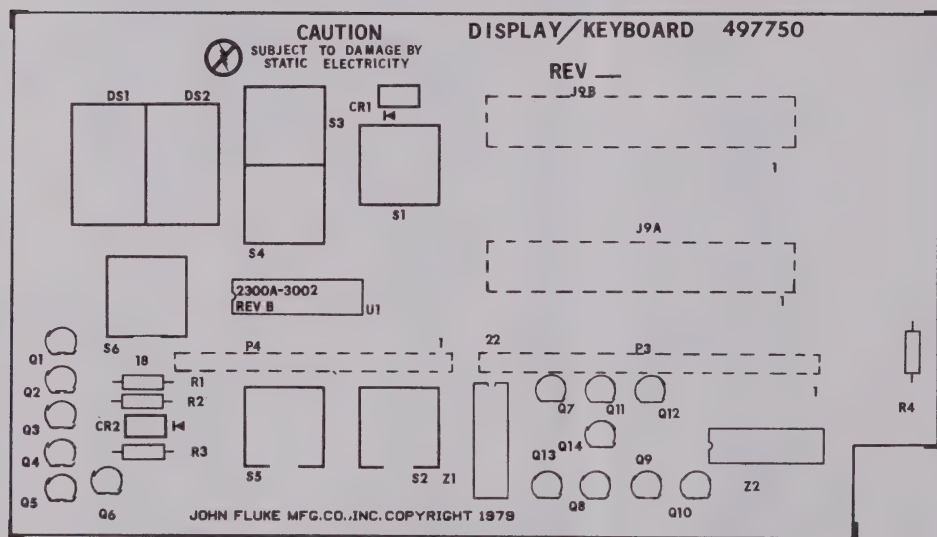
**Figure 8-2. A1 Scanner Control PCB Assembly**





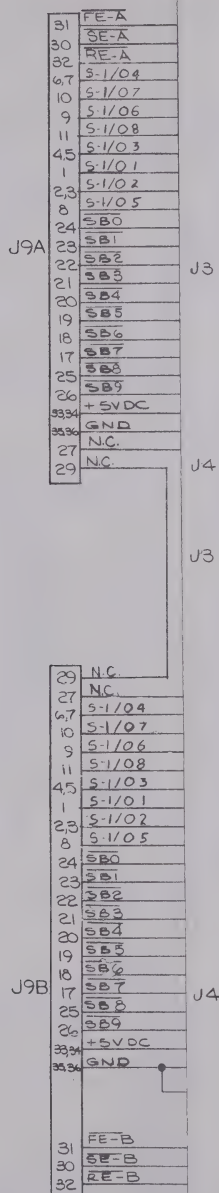
2300A-1001

Figure 8-2. A1 Scanner Control PCB Assembly (cont)



2300A-1602

Figure 8-3. A2, Display/Keyboard PCB Assembly



|    | +5V | GND |
|----|-----|-----|
| U1 | 16  | 8   |

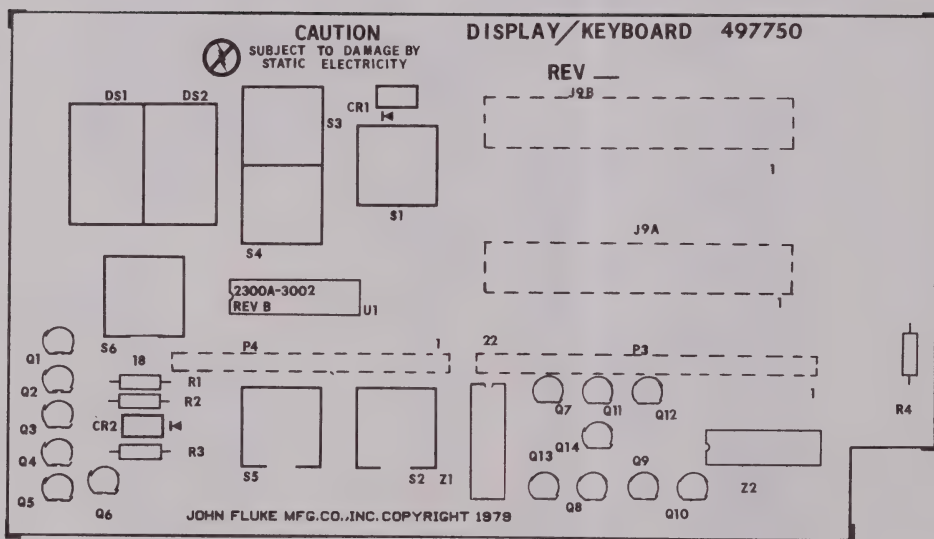
| LAST USED                     |
|-------------------------------|
| R4, CR2, Q14, U1, DS2, SG, Z2 |

NOTES: UNLESS OTHERWISE SPECIFIED.

1. ALL RESISTANCE IS IN OHMS AND ALL CAPACITANCE IS IN MICROFARADS .
2. ALL RESISTORS ARE 1/4W, 5% .
3. ALL GRAPHIC SYMBOLS ARE IN ACCORDANCE WITH ANSI Y32.2 AND Y32.14 .

2300A-1002

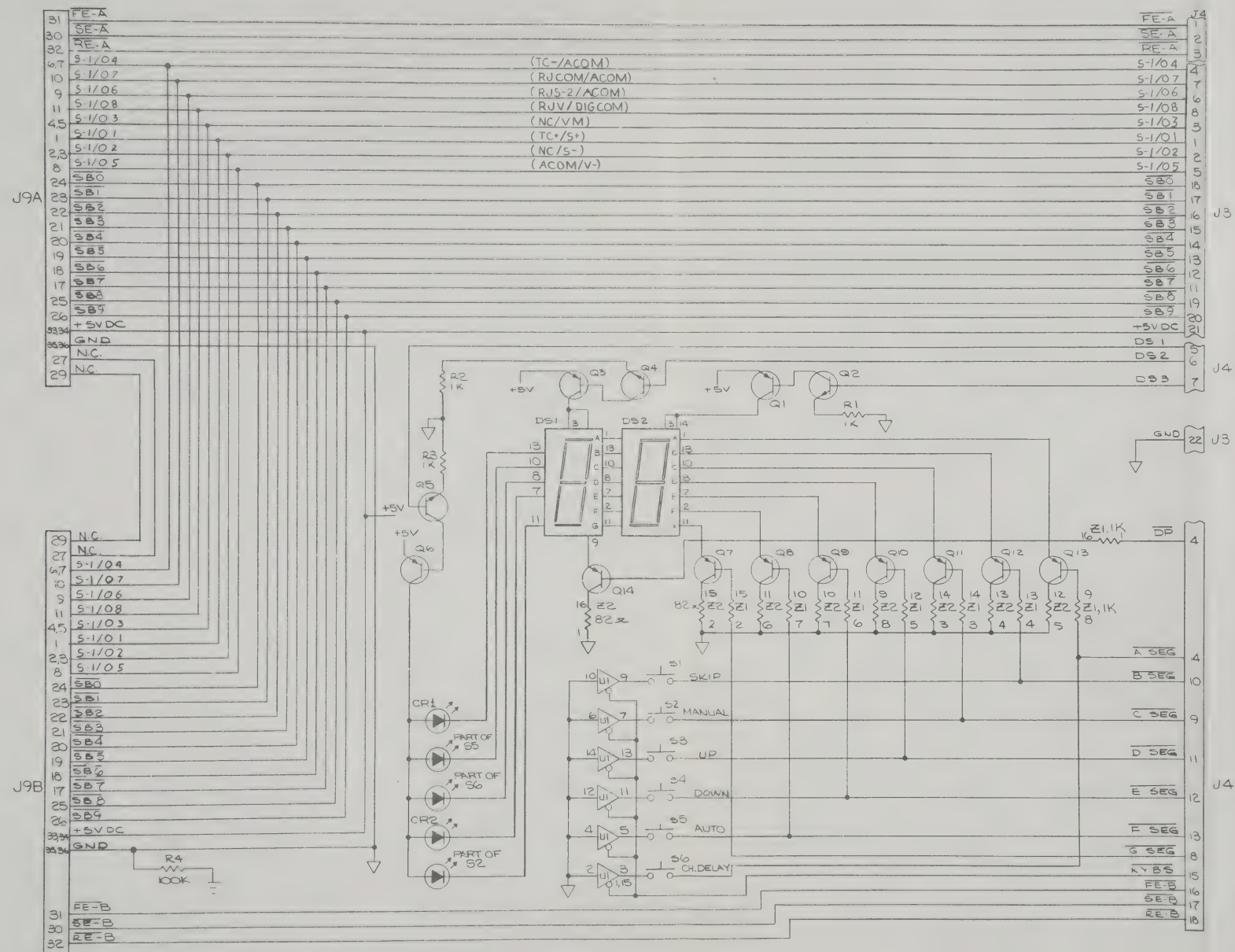
Figure 8-3. A2, Display/Keyboard PCB Assembly (cont)



2300A-1602

Figure 8-3. A2, Display/Keyboard PCB Assembly

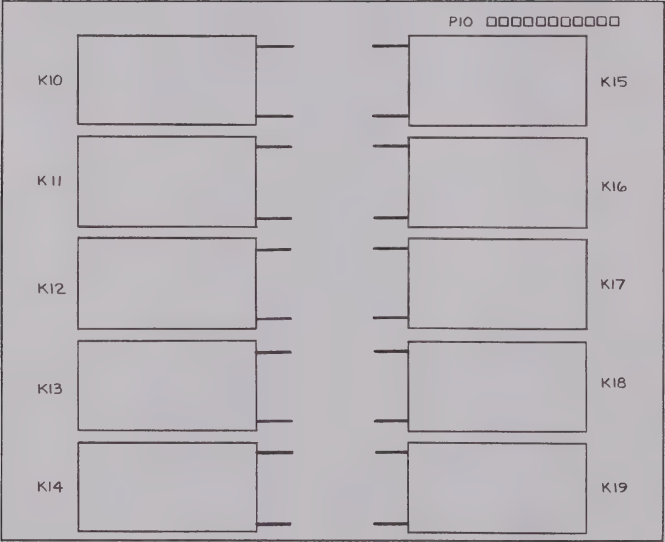




2300A-1002

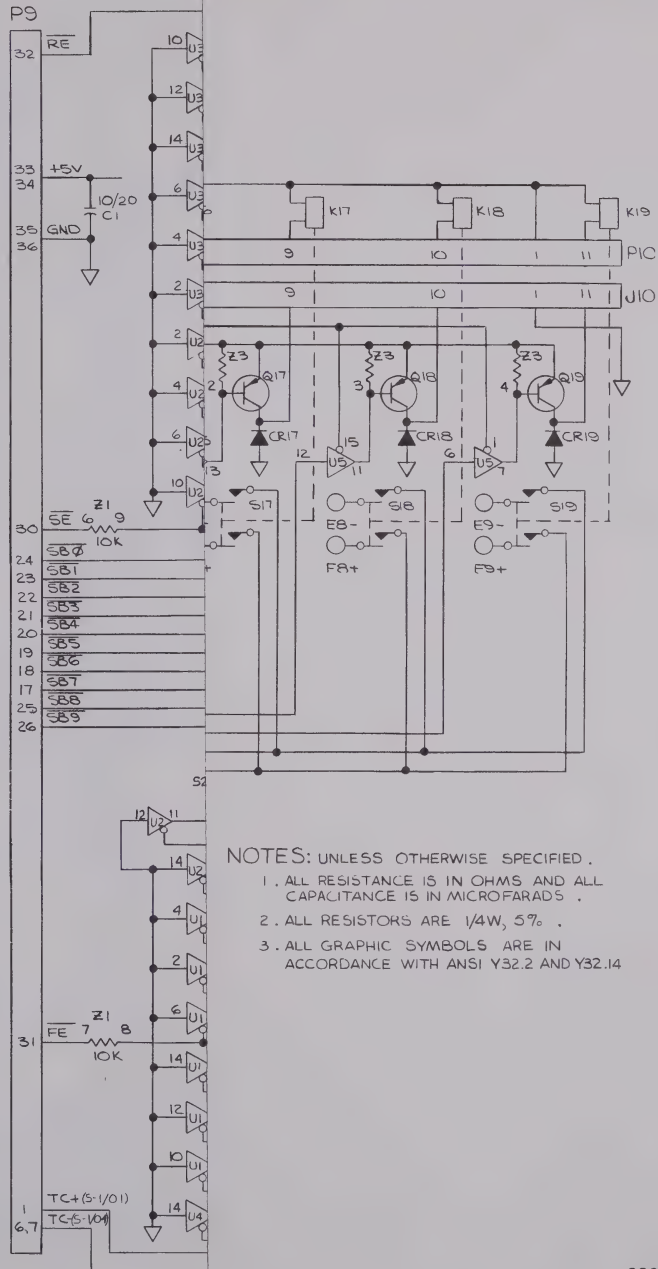
Figure 8-3. A2, Display/Keyboard PCB Assembly (cont)





2300A-1620

Figure 8-4. Option-002, Thermocouple  
Scanner PCB Assembly



NOTES: UNLESS OTHERWISE SPECIFIED.

1. ALL RESISTANCE IS IN OHMS AND ALL CAPACITANCE IS IN MICROFARADS.
2. ALL RESISTORS ARE 1/4W, 5%.
3. ALL GRAPHIC SYMBOLS ARE IN ACCORDANCE WITH ANSI Y32.2 AND Y32.14.

2300A-1020

Figure 8-4. Option-002, Thermocouple Scanner PCB Assembly (cont)

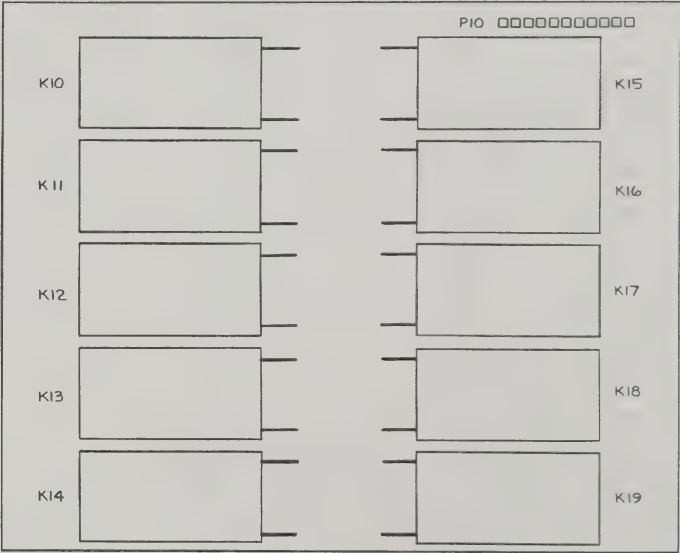
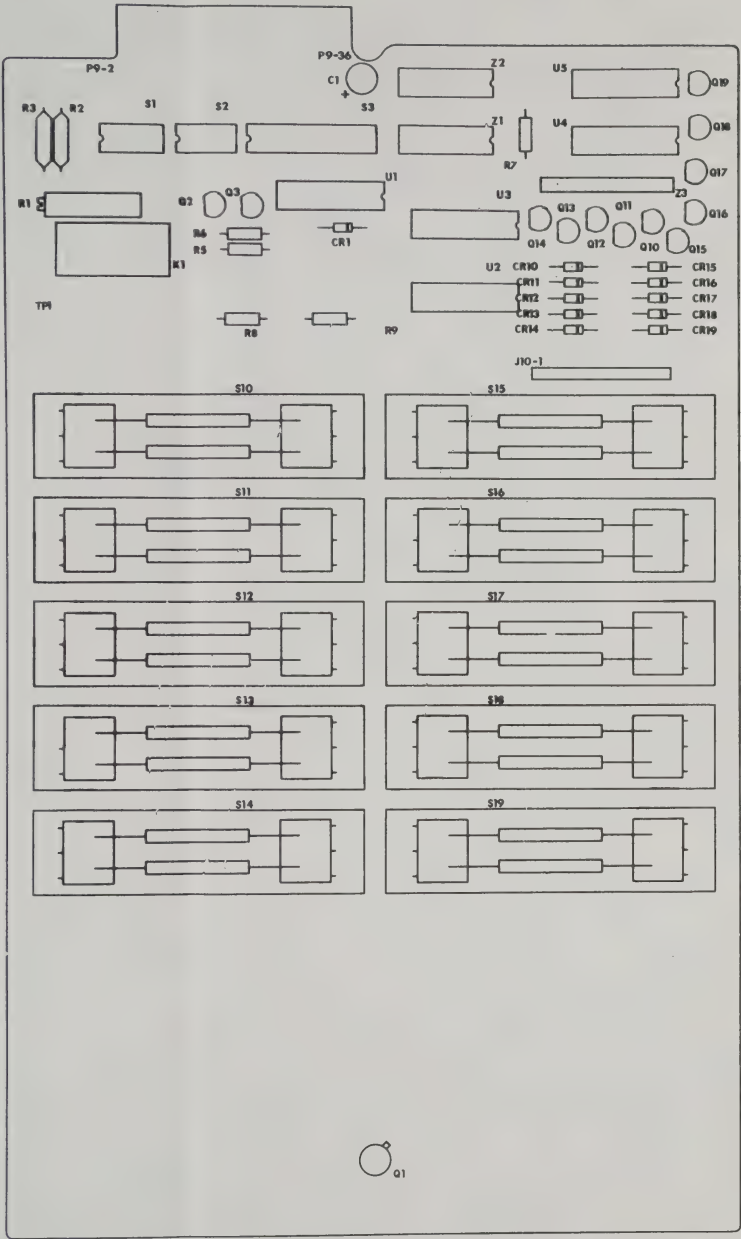
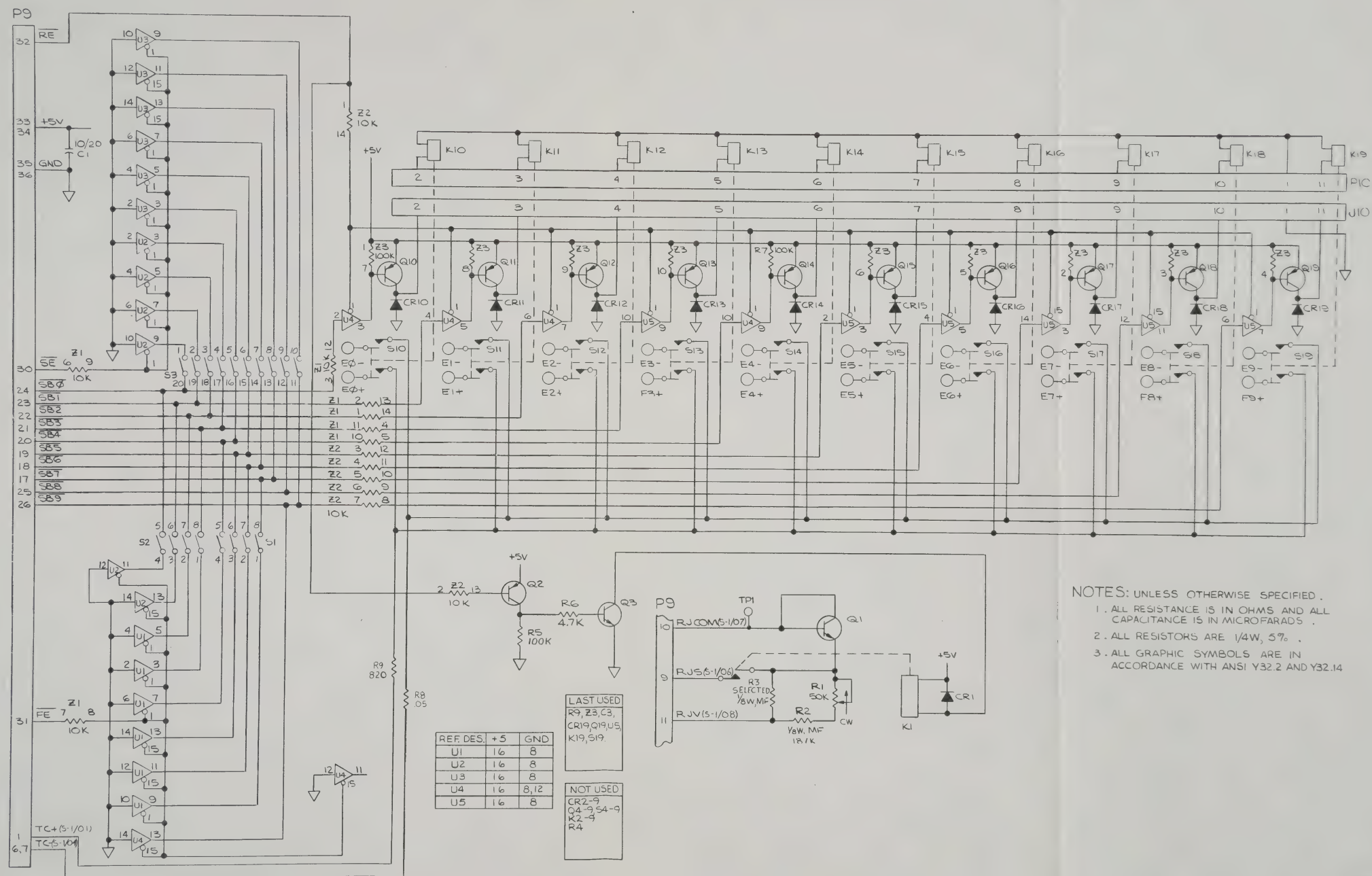
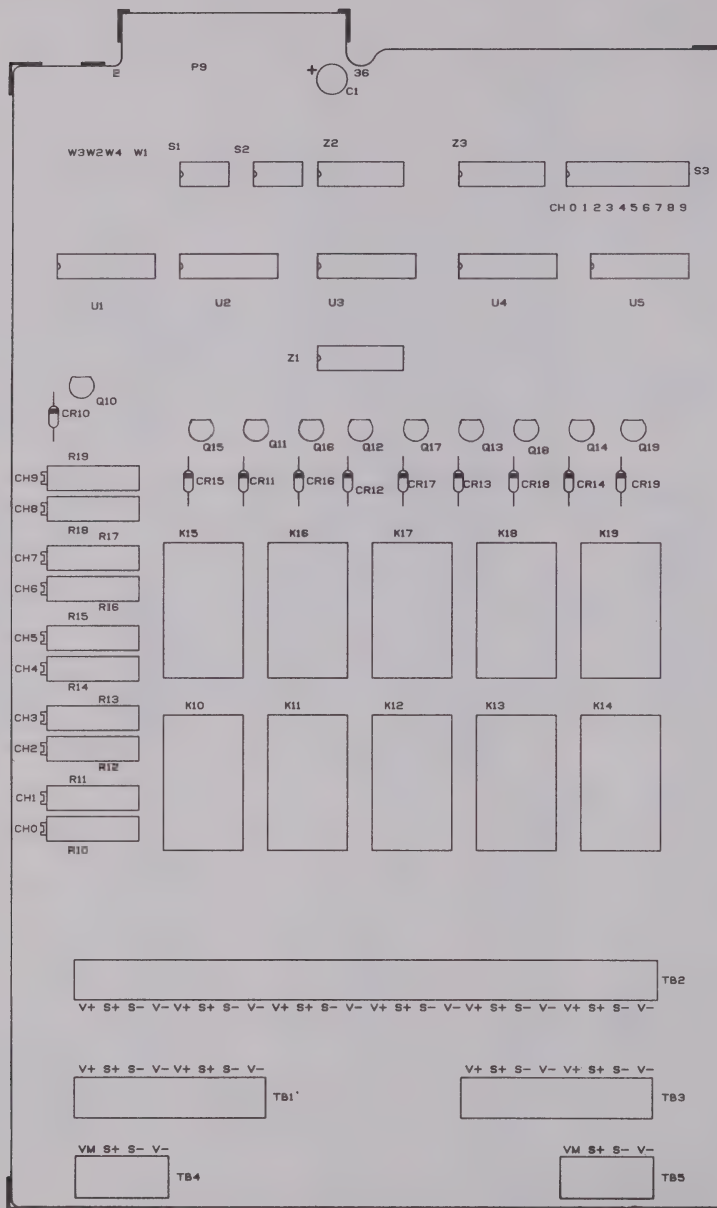


Figure 8-4. Option-002, Thermocouple Scanner PCB Assembly



2300A-1020

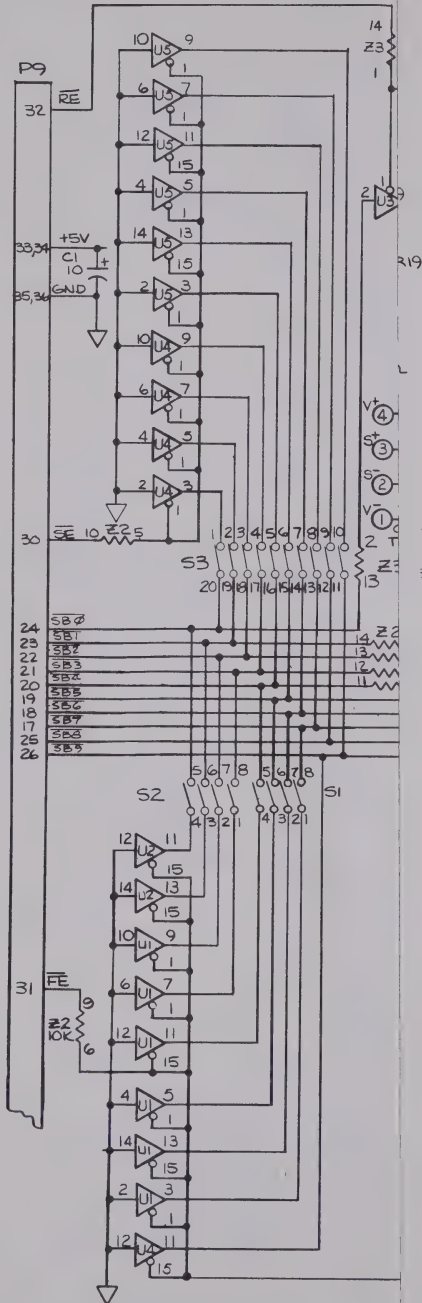
Figure 8-4. Option-002, Thermocouple Scanner PCB Assembly (cont)



2300A-1630

Figure 8-5. Option-003, RTD/OHMS  
Scanner PCB Assembly





# NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTANCE IS IN OHMS AND ALL CAPACITANCE IS IN MICROFARADS
2. ALL GRAPHIC SYMBOLS ARE IN ACCORDANCE WITH ANSI Y32.2 AND Y32.14.
3. ALL RESISTORS ARE 1/4W, 5%.

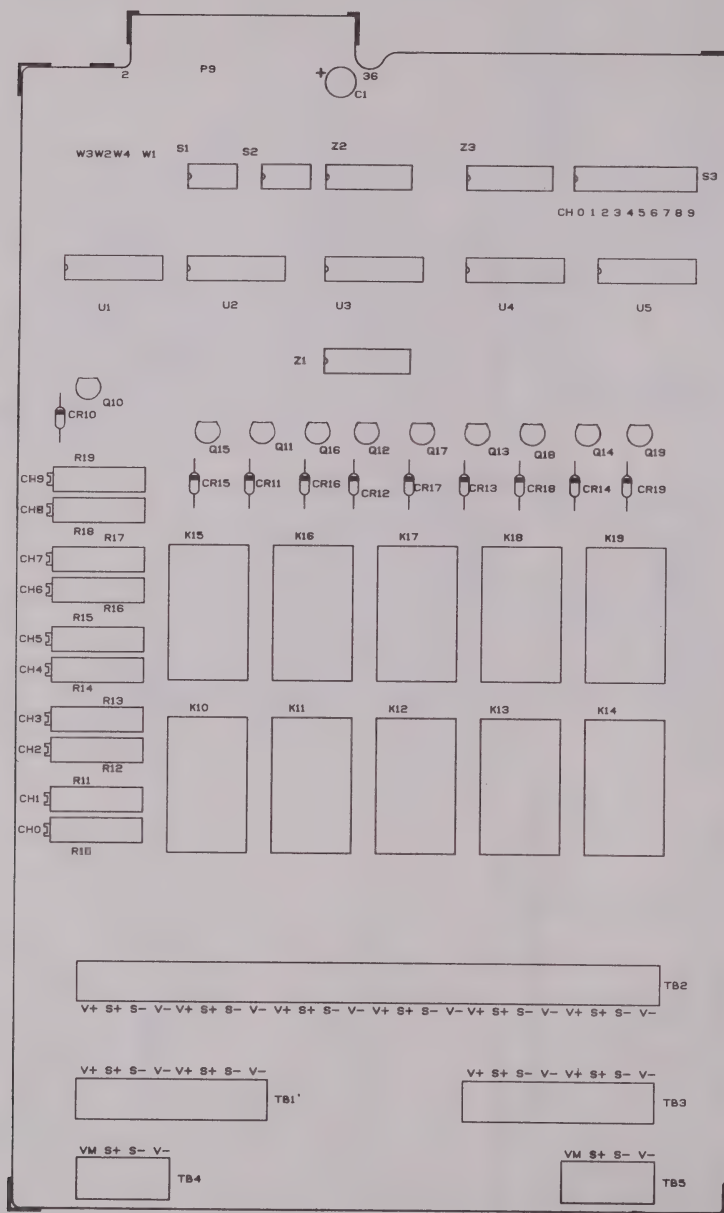
| DEVICE | GND | +5V |
|--------|-----|-----|
| U1     | 8   | 16  |
| U2     | 8   | 16  |
| U3     | 8   | 16  |
| U4     | 8   | 16  |
| U5     | 8   | 16  |
| Z1     |     | 14  |

| LAST USED   |
|-------------|
| R19, C1, S3 |
| CR15, K19   |
| TB5, Q19    |
| U5, Z3      |

| NOT USED |
|----------|
| R1-R9    |
| CR1-CR9  |
| Q1-Q9    |
| K1-K9    |

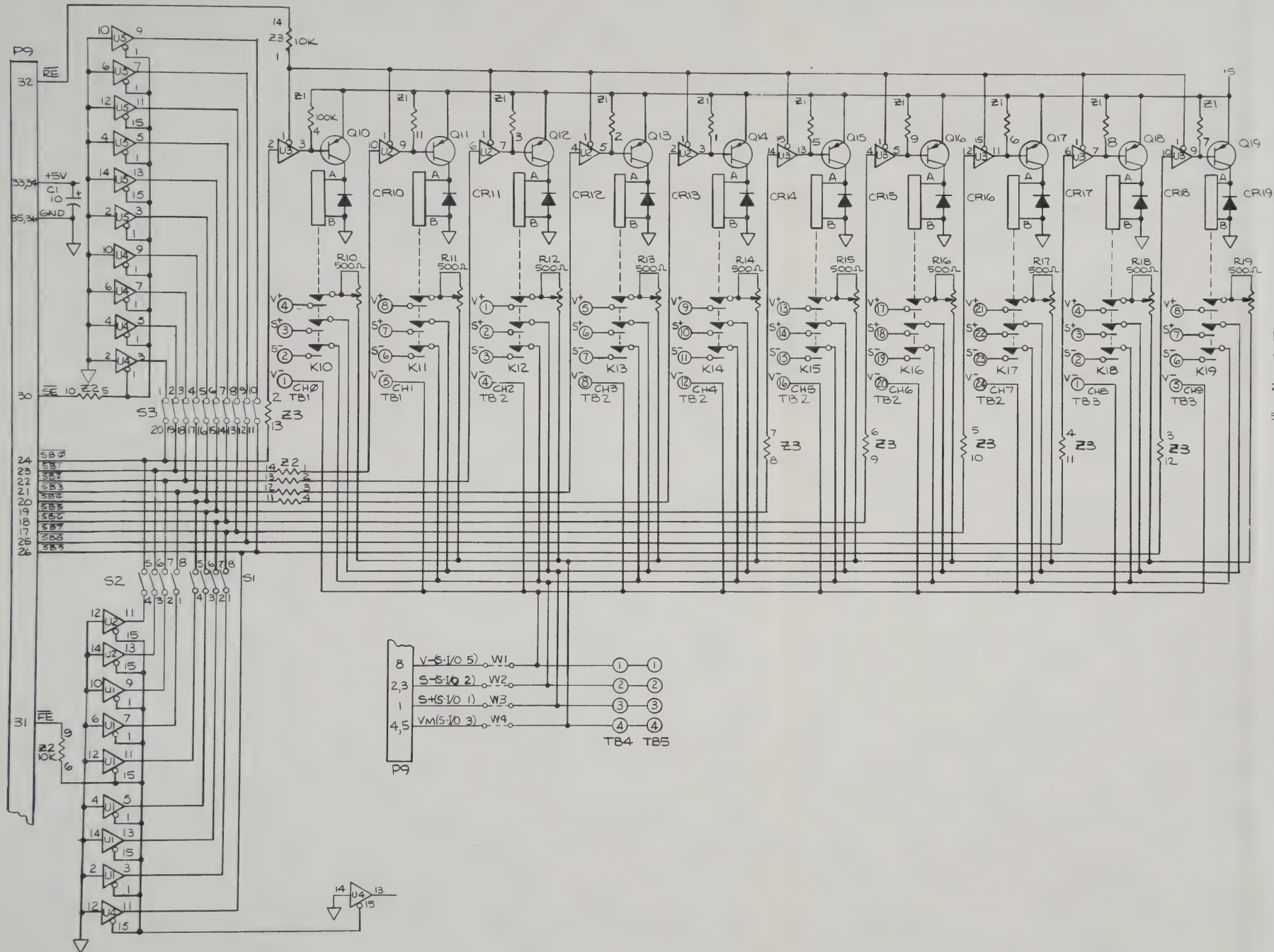
2300A-1030

Figure 8-5. Option-003, RTD/OHMS  
Scanner PCB Assembly (cont)



2300A-1630

Figure 8-5. Option 003, RTD/OHMS  
Scanner PCB Assembly



- NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTANCE IS IN OHMS AND ALL CAPACITANCE IS IN MICROFARADS
  2. ALL GRAPHIC SYMBOLS ARE IN ACCORDANCE WITH ANSI Y32.2 AND Y32.14.
  3. ALL RESISTORS ARE 1/4W, 5%.

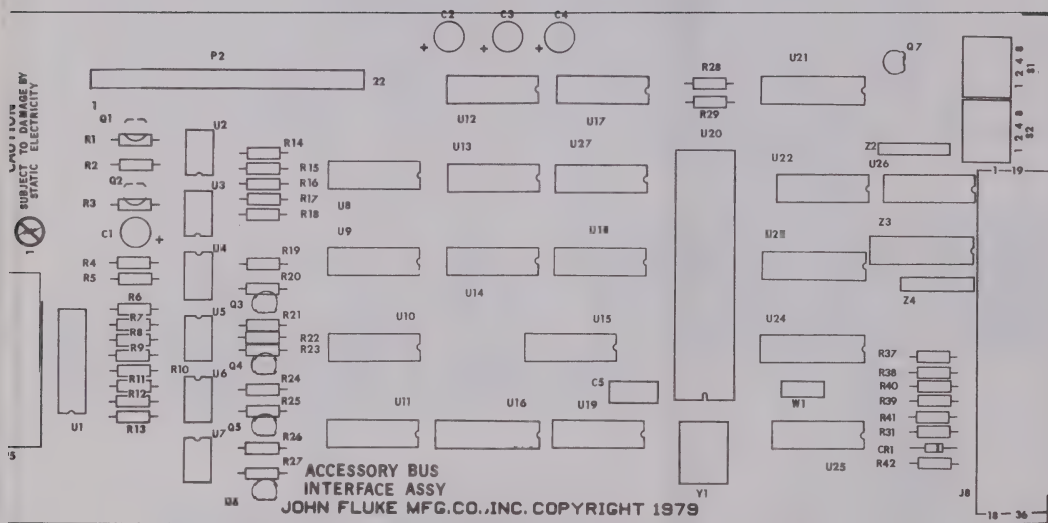
| DEVICE | GND | +5V |
|--------|-----|-----|
| U1     | 8   | 16  |
| U2     | 8   | 16  |
| U3     | 8   | 16  |
| U4     | 8   | 16  |
| U5     | 8   | 16  |
| Z1     |     | 14  |

| LAST USED   |
|-------------|
| R19, C1, S3 |
| CR9, K19    |
| TB5, Q19    |
| U5, Z3      |

| NOT USED |
|----------|
| R1-R9    |
| CR1-CR9  |
| Q1-Q9    |
| K1-K9    |

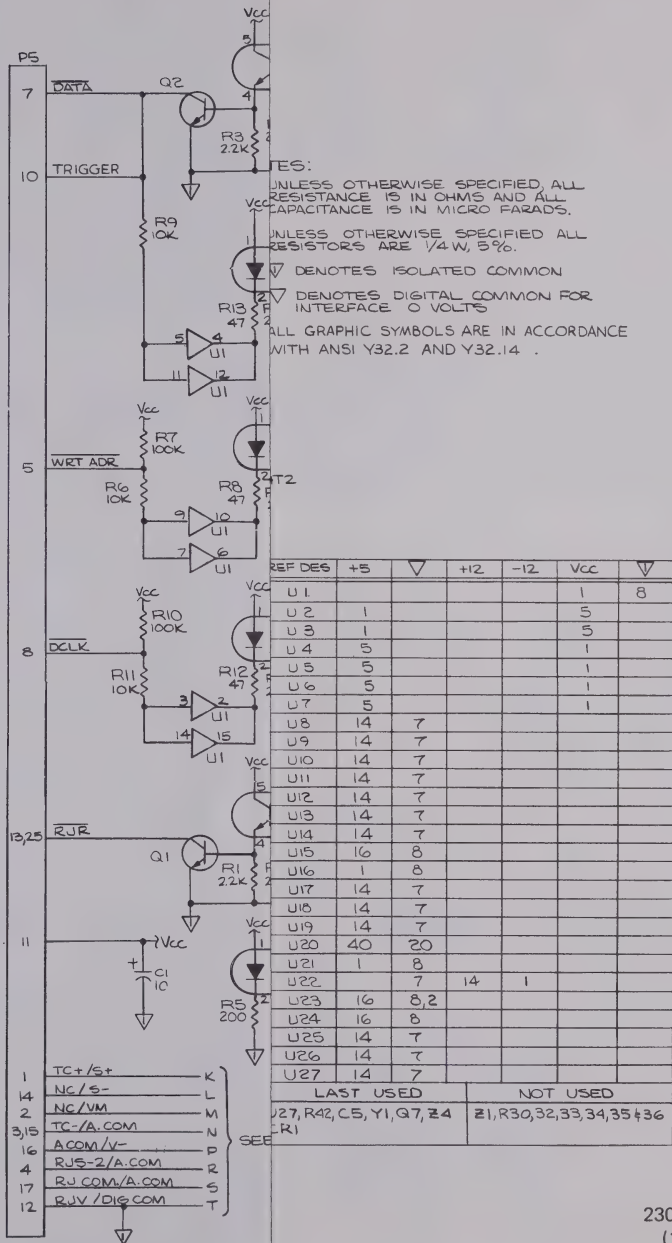
2300A-1030

Figure 8-5. Option-003, RTD/OHMS Scanner PCB Assembly (cont)



2300A-1650

Figure 8-6. Option-005, Accessory Bus  
Interface PCB Assembly



2300A-1050  
(1 OF 2)

Figure 8-6. Option-005, Accessory Bus  
Interface PCB Assembly (cont)



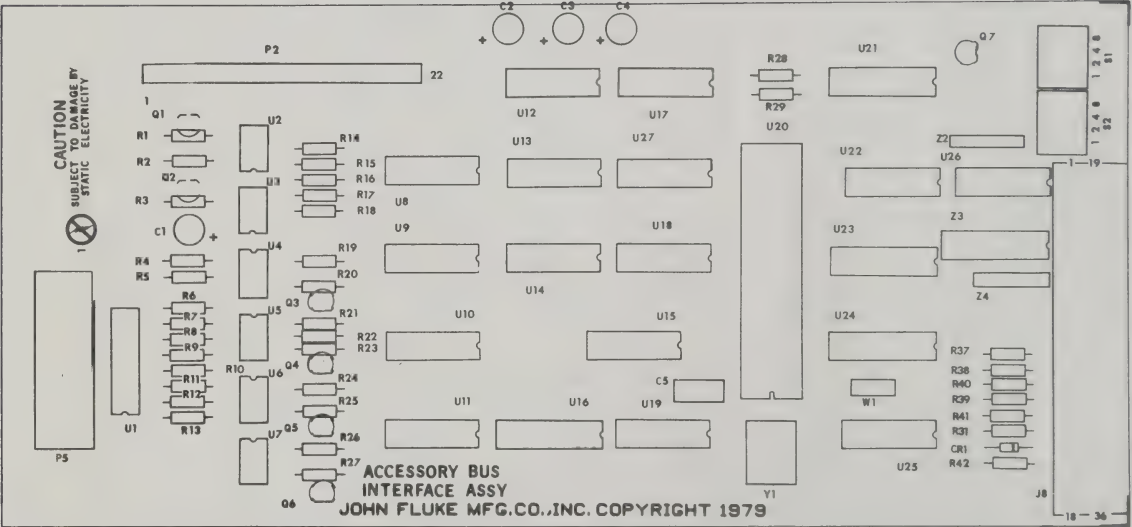
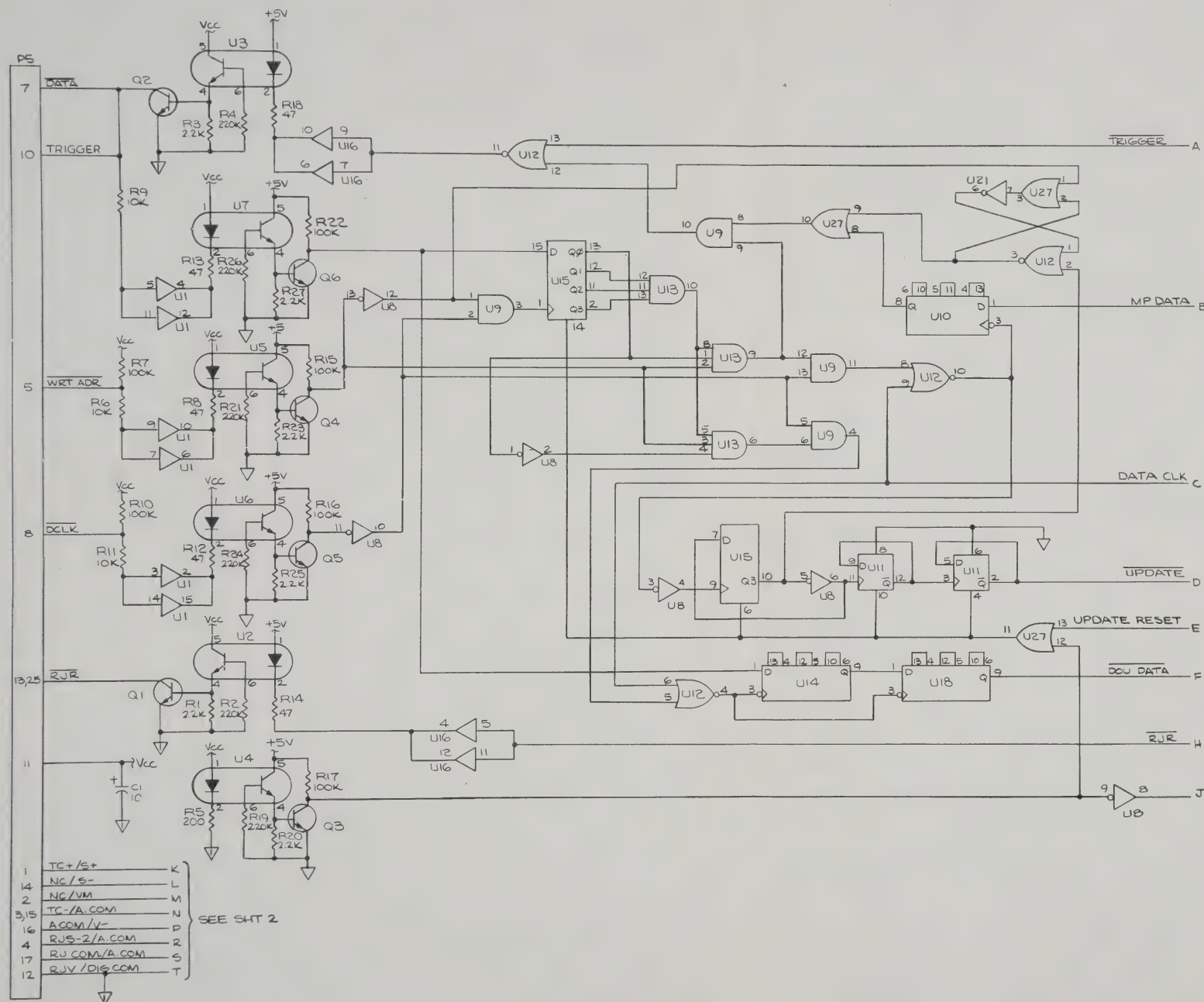


Figure 8-6. Option-005, Accessory Bus Interface PCB Assembly



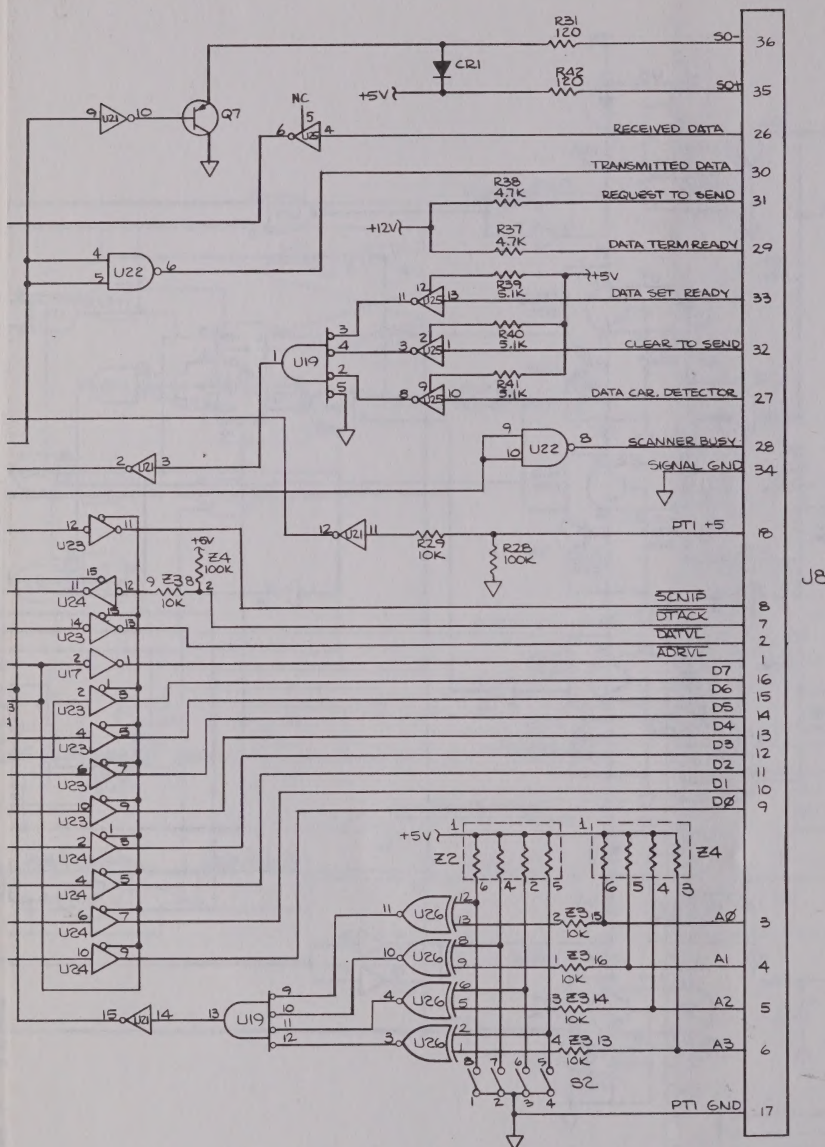
## NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTANCE IS IN OHMS AND ALL CAPACITANCE IS IN MICRO FARADS.
2. UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE 1/4 W, 5%.
3. ▽ DENOTES ISOLATED COMMON
4. ▽ DENOTES DIGITAL COMMON FOR INTERFACE 0 VOLTS
5. ALL GRAPHIC SYMBOLS ARE IN ACCORDANCE WITH ANSI Y32.2 AND Y32.14

SEE SHT 2

| REF DES                  | +5 | ▽                            | +12 | -12 | VCC | ▽ |
|--------------------------|----|------------------------------|-----|-----|-----|---|
| U1                       |    |                              |     |     | 1   | 8 |
| U2                       | 1  |                              |     |     | 5   |   |
| U3                       | 1  |                              |     |     | 5   |   |
| U4                       | 5  |                              |     |     | 1   |   |
| U5                       | 5  |                              |     |     | 1   |   |
| U6                       | 5  |                              |     |     | 1   |   |
| U7                       | 5  |                              |     |     | 1   |   |
| U8                       | 14 | 7                            |     |     |     |   |
| U9                       | 4  | 7                            |     |     |     |   |
| U10                      | 14 | 7                            |     |     |     |   |
| U11                      | 14 | 7                            |     |     |     |   |
| U12                      | 14 | 7                            |     |     |     |   |
| U13                      | 14 | 7                            |     |     |     |   |
| U14                      | 14 | 7                            |     |     |     |   |
| U15                      | 16 | 8                            |     |     |     |   |
| U16                      | 1  | 8                            |     |     |     |   |
| U17                      | 14 | 7                            |     |     |     |   |
| U18                      | 14 | 7                            |     |     |     |   |
| U19                      | 14 | 7                            |     |     |     |   |
| U20                      | 40 | 20                           |     |     |     |   |
| U21                      | 1  | 8                            |     |     |     |   |
| U22                      | 7  | 14                           | 1   |     |     |   |
| U23                      | 16 | 8, 2                         |     |     |     |   |
| U24                      | 16 | 8                            |     |     |     |   |
| U25                      | 14 | 7                            |     |     |     |   |
| U26                      | 14 | 7                            |     |     |     |   |
| U27                      | 14 | 7                            |     |     |     |   |
| LAST USED                |    | NOT USED                     |     |     |     |   |
| U27, R42, C5, Y1, Q7, Z4 |    | Z1, R30, 32, 33, 34, 35 & 36 |     |     |     |   |
| CR1                      |    |                              |     |     |     |   |

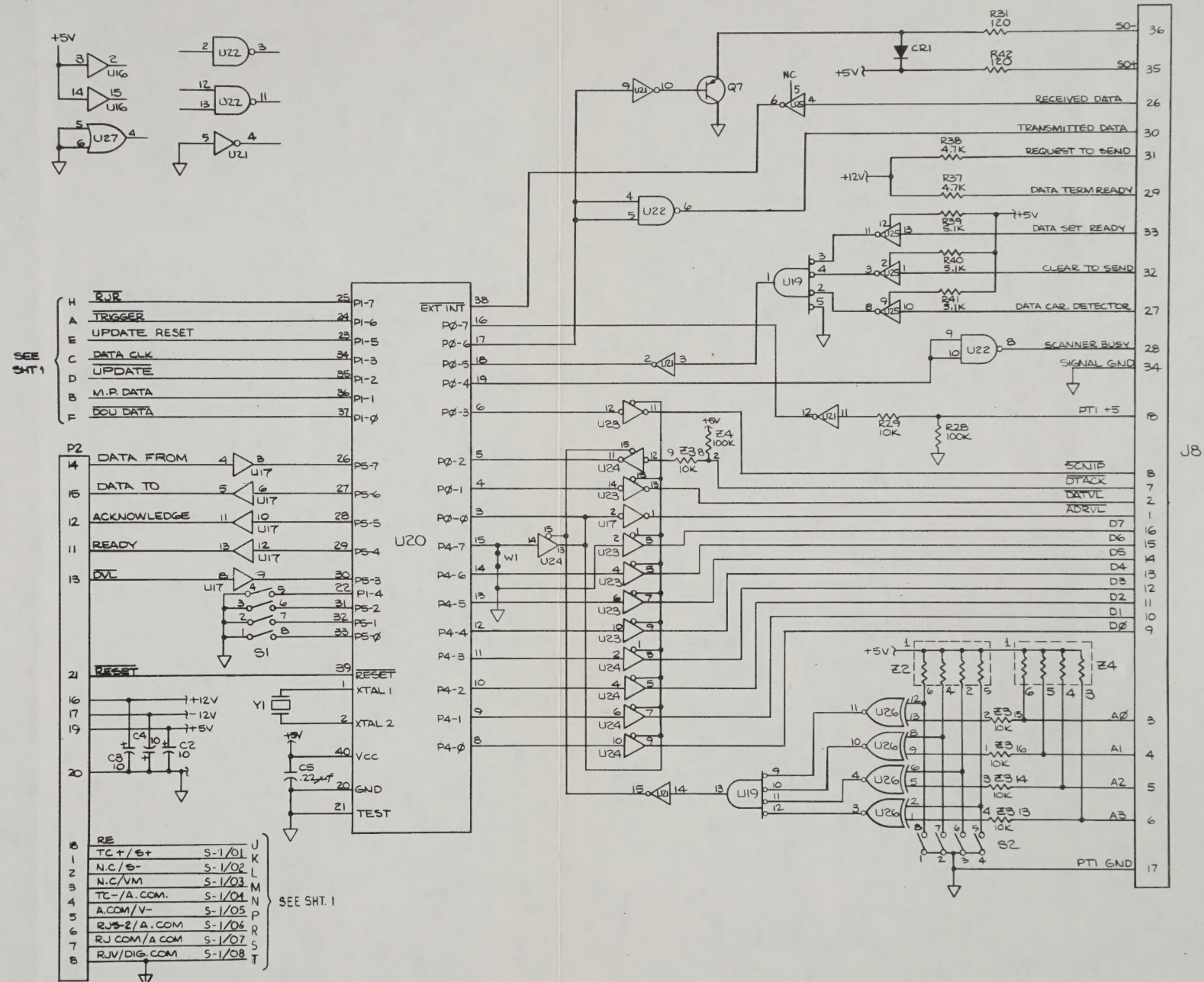
2300A-1050  
(1 OF 2)Figure 8-6. Option-005, Accessory Bus  
Interface PCB Assembly (cont)



2300A-1050  
(2 OF 2)

Figure 8-6. Option-005, Accessory Bus  
Interface PCB Assembly (cont)





**Figure 8-6. Option-005, Accessory Bus Interface PCB Assembly (cont)**







